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ELEMENTARY CLASS-BOOK

OF

PHYSICAL GEOGRAPHY.

BY

WILLIAM HUGHES, F.R.G.S.,

AUTHOR OF "CLASS-BOOK OF PHYSICAL GEOGRAPHY,"
"MANUAL OF GEOGRAPHY," ETC.

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CONTENTS.

PAGE

I. THE EARTH AS A PLANET, ... 1-12

Size and Shape of the Earth—Its Diurnal and Annual Motions—Cause of Day and Night, . 2
The Seasons, ... 8
Definitions, ... 10

II. GENERAL FEATURES OF THE EARTH'S SURFACE, . 13-17

Land and Water—The Continents, . . 13
Coast Lines—Highlands and Lowlands, . . 14
Definitions, ... 16

III. HIGHLANDS AND MOUNTAIN-CHAINS OF THE OLD WORLD, 18-24

List of Table-Lands, ... 18
Mountain Chains, ... 19
Mountain Passes, ... 21
The Himalaya Mountains, ... 21
The Alps—the Scandinavian Mountains, . . 22
Glaciers, ... 23

IV. HIGHLANDS AND MOUNTAIN-CHAINS OF THE NEW WORLD, 25-28

List of Table-Lands, ... 25
Mountain Chains—The Rocky Mountains—The Alleghany, ... 26
The Andes, ... 27

V. LOWLAND PLAINS, ... 29-31

Steppes, Prairies, Llanos, Selvas, Pampas, . 31

VI. DESERTS, ... 32 34

PAGE
VII. Rivers and Lakes, ... 35-40
Definition of Terms, ... 35
European Rivers, ... 36
Asiatic and African Rivers, . . . 38
American Rivers, ... 39
Lakes, ... 39

VIII. The Ocean, ... 41-48
Depth of the Sea, ... 42
Temperature, Saltness, Specific Gravity, and Colour of Sea, ... 43
Currents, ... 44
The Gulf Stream, ... 46
Waves: Co-tidal Lines, ... 47

IX. The Atmosphere, ... 49-55
The Calm Latitudes, ... 50
The Trade Winds, ... 51
The Monsoons, ... 52
Land and Sea Breezes, ... 54

X. Climate, ... 56-64
Names of Particular Winds, . . . 60
Isothermal Lines, ... 61
Rain, Geographical Distribution of, . . 63

XI. Agents of Change, ... 65-70
Mineral Composition of the Earth's Crust, . 65
Earthquakes and Volcanic Eruptions, . . 67
List of Principal Volcanoes, . . . 70
Coral Islands, ... 70

XII. Natural Productions of the Earth—Minerals, . 71-76

XIII. Natural Productions of the Earth—Plants, . 77-82
Geographical Distribution of Food Plants, . 79

XIV. Natural Productions of the Earth—Animals, . 83-90
European Zoology, ... 85
Asiatic do., ... 85
African do., ... 86
American do., ... 87
Australian do., ... 89

XV. Geographical Distribution of Man, . . . 91-95

PHYSICAL GEOGRAPHY.

I.

THE EARTH AS A PLANET.

Physical Geography is *natural geography*—or the description of the natural world; that is, the description of its mountains, plains, valleys, rivers, lakes, seas, and also of the climates of various parts of the earth, and of their chief productions, mineral, vegetable, and animal. Such a range of subjects must evidently embrace a vast number of things that have a direct reference to the life and habits of man, and a direct bearing upon his condition as a civilised and social being. For instance, upon the climate of a country will depend its general healthiness or unhealthiness, the kind of clothing which its inhabitants must wear, and a vast number of the every-day habits and customs of life.

1. **The Earth** is one amongst a number of bodies that revolve in elliptical paths or orbits round the Sun. These bodies are called *Planets*. The Earth is the third planet in order of distance from the Sun, the planet Mercury being the first in order, and Venus the second. At greater distances from the Sun there occur in succession the planets Mars, Jupiter, Saturn, Uranus, and Neptune; besides a great number of much

smaller planetary bodies, (distinguished as asteroids,) which intervene between the orbits of Mars and Jupiter. The bodies here named are called Primary Planets. Some of them are attended by secondary bodies, or *Satellites*, which move in orbits round their primaries. Thus, the Earth is attended by the Moon, a planetary body which performs a monthly orbit round the earth, and is intimately connected with the movements of the ocean. In like manner, the planet Jupiter is attended by four moons, or satellites, Saturn by eight, and Uranus by four moons. The Sun, the Planets, and their attendant Satellites, together with the bodies known as Comets, constitute the *Solar System*.

The bodies composing the Solar System are but a very few amongst the total number of bright, shining points, or *stars*, that are visible on a clear night. The vastly greater number of these—all, indeed, but the planets—are called Fixed Stars, because they always keep the same places relatively to one another. The planets, on the contrary, appear to move *amongst* the fixed stars.

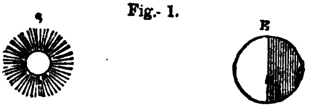
2. The Earth is a globe or sphere in shape—not, indeed, quite round, but a very little flattened towards the poles, somewhat in the way that an orange is, though to a much less extent. The shape is so nearly round that it may be considered as a perfect globe. The *diameter* of the Earth—*i.e.*, a line drawn through the centre of the globe, from one side to the other—measures, in round numbers, 8000 miles. The *circumference* of the Earth—that is, the measure of a line drawn entirely round it—is about 25,000 miles.

3. The Earth has two kinds of motion—one a rotation, or movement round an imaginary line called its axis, similar to the motion of a top when spinning ; the other, a motion in a path or orbit round the Sun, the common centre of the planets. The former of these movements is called *diurnal* (or daily,) because it is accomplished once in every twenty-four hours ; the latter is called *annual* (yearly,) because its completion takes a year. Both movements—the diurnal and the annual

—are in constant performance. The Earth's diurnal movement is the cause of day and night. Its annual movement occasions the successive seasons of the year.

Day and Night.—To understand how the Earth's rotation on its axis occasions day and night it is only necessary to hold a ball, (or globe of any sort, or an apple or an orange,) before a lamp or lighted candle in a darkened room; that half of the ball which is *towards* the candle will receive its light, while the other half will be left in darkness. The influence of the Sun upon the Earth is exactly similar, as the following figure will show:—

Fig. 1.



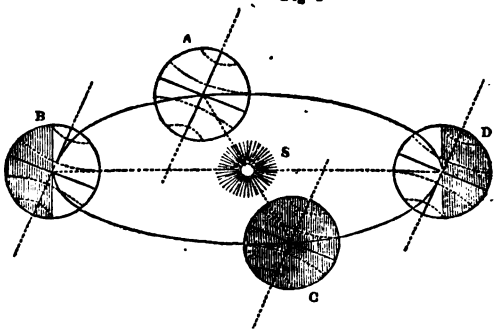
It is only from the Sun that the Earth derives its light. If S represent the Sun, and E the Earth, it is clear that half the Earth will be receiving the light of the Sun, while the other remains in darkness.

If while holding the ball before a lighted candle we turn it slowly round, every part of the surface of the ball will be successively brought within the influence of the light, and afterwards pass again into darkness. In like manner, if we suppose the figure E, in the diagram, to turn round upon its axis, the enlightened half will pass gradually into the place of the darker half, and the reverse.

The Earth's rotation on its axis is performed in an *eastwardly* direction—*i.e.*, the Earth revolves from *west to east*. Hence, as the globe turns round, it is (with reference to any supposed point on its surface) the eastwardly portion that first receives the Sun's light; the result is, that the Sun *appears* to rise on the eastern side of the heavens, and to sink on the western side. It is the same with all the other heavenly bodies. The Sun, Moon, and Stars, the whole visible face of the heavens, appear to be carried round the Earth, from east to west, once in twenty-four hours, within which time the periods called Day and Night are successively accomplished.

The Seasons.—The Earth's annual motion accounts for the successive occurrence of the seasons of Spring, Summer, Autumn, and Winter, in a way which the following diagram (fig. 2) will help us to understand. In this diagram the central figure, S, represents the Sun, and the figures A, B, C, D, four positions of the Earth, in the opposite points of its orbit round the sun. Now the axis of the Earth, (*i.e.*, the imaginary line round which its daily rotation is performed,) instead of being at right angles to the plane of its orbit, is *inclined* to that plane in a certain angle (23½°,) and this angle of inclination is constantly preserved throughout the orbit. This uniform inclination of the Earth's axis in space is shown in the slanting lines—parallel to one another—in the four positions of the Earth, A, B C, D, in the diagram. In two of these positions, A, and C, the line of division between the light and dark halves of the Earth touches each of the Earth's poles—so that the whole space from pole to pole falls equally either with the enlightened or the dark half of the globe's surface. But in the two other positions, B and D, the line which divides the dark half from the enlightened half differs by an amount of 23½° from the line of the Earth's axis, and hence each pole

Fig 2



is left either wholly *within*, or wholly *beyond*, the line of division between light and darkness.

The condition here stated explains the unequal length of the days and nights which, (in all parts of the earth excepting those immediately under the line of the equator,) occur in the course of the year. The positions of the Earth marked A and C in the diagram correspond to the seasons of the spring and autumn equinoxes, when day and night are of equal duration, each being twelve hours long. The position B shows the summer of the northern hemisphere, when long days (and correspondingly short nights) occur within those parts of the globe that lie between the equator and the north pole. The position D is the winter of the northern hemisphere, the season of long nights and short days towards the northern pole. In the southern hemisphere, on the contrary, D is the season of long days and short nights, *i.e.*, of summer ; while B is that of long nights and short days, or winter.

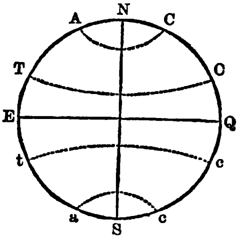
The Earth performs a complete passage through its orbit once in every year. The position A is one of equal day and night throughout the globe. While the Earth is passing from A to B, the days are gradually growing of *more* than twelve hours' duration, and the nights *less* than twelve hours long, within the northern hemisphere, while within the southern hemisphere the reverse is the case. At B the mid-summer of the northern hemisphere, and the mid-winter of the southern half of the globe, are attained. In passing from B to C the days and nights are gradually approaching equality, and the position C is again that of equal periods of light and darkness throughout the earth. From C to D is a period of increasing length of day in the southern half of the globe, and of diminishing periods of daylight to the north of the equator. D is the midsummer of the southern, and the mid-winter of the northern hemisphere. From D to A exhibits, again, a gradual return towards the condition of equality in the length of day and night. The position A corresponds to the season of spring, in the northern hemisphere ; that of C to that of autumn. In the southern half of the globe, on the other hand, the position C is that of spring, and A that of autumn.

The following **definitions** should be committed to memory:—

1. The Earth's **Axis** is an imaginary line drawn through its centre, and around which its diurnal rotation is performed.

2. **The Poles** of the Earth are the extremities of its axis: one of them is distinguished as the *North*, the other as the *South* Pole. In the figure, No. 3, the line N S represents the axis; N the North pole, and S the South pole.

Fig. 3.



3. **The Equator** is an imaginary circle drawn round the Earth, midway between the poles, and therefore dividing the surface of the Earth into two halves or hemispheres, as the line E Q in the figure.

4. **Latitude** is distance measured from the equator in the direction of either pole: if towards the north pole, it is called north latitude; if towards the south pole, south latitude. It is expressed in degrees, minutes, and seconds, which are indicated by the signs ° ′ ″: thus 25° 10′ 40″ means twenty-five degrees, ten minutes, forty seconds.

Every circle is supposed to be divided into 360°, so that the distance from E. to N., or from E. to S., is equal to 90° (*i.e.*, a quarter of 360°.) Hence, the greatest latitude which a place can have is 90°.

5. **Parallels of Latitude** are circles drawn round the globe parallel to the equator. On artificial globes they are commonly drawn at 10° apart; on maps, at every 5°, or 2°, or

sometimes at every single degree, according to the size and scale of the map.

6. **The Tropics** are circles drawn parallel to the equator, at distances of 23½° on either side, as the lines T C, t c, in the figure. The Northern tropic, T C, is called the tropic of Cancer; the Southern tropic, t c, the tropic of Capricorn.

The tropics mark the farthest limits within which the Sun is vertical to the Earth's surface, throughout the whole of the Earth's annual path, or orbit. In fig. 2, (p. 4,) the position of the Earth marked B shows the Sun as shining vertically over the tropic of Cancer; in the position D the Sun is vertical over the tropic of Capricorn.

7. **The Polar Circles** are lines drawn round the globe, parallel to the equator, at a distance of 23½° from either pole, or 66½° from the equator, as the lines A C, a c, in the figure. That drawn round the north pole, A C, is distinguished as the Arctic circle; that round the south pole, a c, is called the Antarctic circle.

The Polar Circles mark the limits within which periods of light or darkness exceeding 24 hours in length occur, according to the Earth's place in its orbit. In fig. 2, the positions of the Earth at B and D show the line of division between the enlightened and the dark halves of the globe as just *touching* the opposite sides of the Arctic and Antarctic Circles, so that the whole of one of those circles falls within the light half, and the whole of the other within the dark half. In the positions A and C the entire space within the Polar Circles is either wholly within the enlightened half, or altogether within the darkened hemisphere.

8. The tropics and polar circles divide the surface of the Earth into five **Zones**, called respectively Torrid, North Temperate, South Temperate, North Frigid, and South Frigid.

The *Torrid Zone* is the space comprehended between the tropics—that is, between the lines T C, t c, in the figure. The Sun is always vertical to some part or other of this zone.

The *North and South Temperate Zones* are the spaces comprehended between the tropics and the polar circles. Thus, the space included between the lines T C, A C, is the North Temperate Zone; that between t c, a c, the South Temperate Zone.

The *North and South Frigid Zones* are the spaces included within the polar circles. Thus, the portion of the globe contained between the line A C and the pole N, is the North Frigid Zone; that between the line a c and the pole S, the South Frigid Zone.

9. **A Meridian** is a circle supposed to be drawn round the globe in the direction of north and south, passing through the poles, and cutting the equator at right angles. The outside circle of fig. 3 is a meridian, and a similar circle drawn through any point on the Earth's surface would be a meridian also. Upon artificial globes the meridians are generally drawn at every 10°, or else every 15° apart; on maps, at distance of 5°, 2°, or 1°, according to their size.

10. **Longitude** is distance measured in the direction of east and west from any given meridian chosen for the purpose. In Britain, the meridian passing through Greenwich, (where the National Observatory is situated,) is used as a first meridian, and longitude is reckoned in degrees to the east or west of it. Thus, we say a place is so many degrees east of Greenwich, or so many degrees west of Greenwich. The greatest longitude a place can have is 180°, *i.e.*, half-way round the globe, either east or west.

11. **Zenith** is a term used to express the highest point in the heavens at any place—that is, the point which is vertically over any person, or above his head: *Nadir* indicates the extreme opposite point, or that below his feet. In fig. 3 the point Nis in the place of the zenith; S in that of the nadir.

II.

GENERAL FEATURES OF THE EARTH'S SURFACE.

Land and Water.—The whole surface of the globe is equal, in round numbers, to 197,000,000 English square miles. Nearly three-fourths of this surface consists of Water, *i.e.*, oceans, seas, gulfs, &c. The whole of the Land amounts to little more than 50,000,000 square miles.

The land is unequally distributed over the face of the globe. A map of the world shows this clearly; so does an artificial globe. There are great masses of land, which we call Continents, in some parts, and smaller portions of land, or Islands, in others; while over vast portions there is nothing but sea. And the Lands and Seas alike are of very irregular shape. In whatever way we look at the globe this is the case. If we put the globe so that the north pole comes at the top, and the south pole at the bottom, (making the line of the equator coincide with the metal or wooden framework of the globe,) we see that a much larger portion of the land is in the northern than in the southern hemisphere. If we compare the eastern and western halves of the globe, (taking the line of a meridian 20° W. of Greenwich as the division between them,) we find more land in the former than in the latter. The globe may even be placed so as to show the inequality still more strikingly. By bringing London to the place of the zenith, (so that a circle everywhere 90° distant from London becomes the line of division between two hemispheres,) more than nine-tenths of all the land on the earth is seen to lie within the limits of one hemisphere, while the other half is nearly all water.

The Continents.—These are six in number—Europe, Asia, Africa, Australia, North America, South America. The three first-named are joined together, and form one vast mass of land, called the Old World. The two last-named are also joined together, and are called the New World. Australia, the smallest of the continents, (and the one most recently made known to mankind in general,) is distinct from any of the others.

Europe, Asia, and North America, with parts of Africa and South America, lie within the Northern hemisphere. The Southern hemisphere has only one continent—Australia—entirely within it, but parts of Africa and South America are so likewise. Four continents—Europe, Asia, Africa, and Australia—are within the Eastern half of the globe; only two continents—North and South America—within its Western half.

Coast-Lines.—The *contour*, or shape of the land, is very various. Some of the continents have comparatively regular and unbroken coast lines, with few large indentations. This is the case with Africa, and, in less degree, with Australia and South America. Others, like Europe and North America, display very irregular and broken outlines, with deep gulfs and bays penetrating the shores. Asia partakes of the latter characteristic, but in less measure than either Europe or North America.

It is the same with smaller portions of the land. Some have more irregular outlines, and consequently more coast-line, than others. Thus, Britain, Greece, France, Italy, Denmark, are examples of countries with irregular outline or contour of land and sea.

Of all the continents, *Europe* comes first in respect of diversified contour and extent of coast-line comparatively to area of surface; *North America*, second; *Australia*, third; *South America*, fourth; *Asia*, fifth; and *Africa*, sixth.

Highlands and Lowlands.—The comparative elevation, or *relief*, of the land, equally with its outline, exhibits the most various conditions. In some parts of the earth the land rises into mountains, or extended highlands, (*plateaus*, or *table-lands;*) in other parts, forms great plains or valleys, *lowlands.*) Fig. 4, which shows the comparative rise and fall of land in passing across Europe from S. to N., or from the Mediterranean to the Baltic Sea, supplies an example of this. In the left-hand portion of the diagram, which corresponds to southern and central Europe, the land forms high mountains and extended plateaus; towards the north and east, it passes into lowland plains.

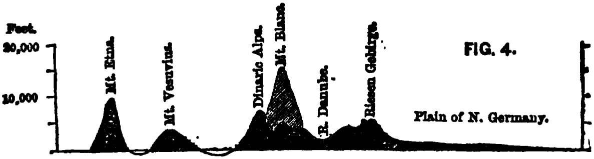


FIG. 4.

It is in Asia, however, that the highest mountains, and the most widely-extending masses of table-land, are found: South America comes next to Asia in this respect. That is, Asia contains the highest mountains on the entire globe: South America, the highest in the New World.

In general, mountain-chains lie not far distant from one of the great oceans, and present a steeper slope on the side which is towards the sea than they do on the opposite or inland side. Thus, the highest mountain-chains of Europe lie near the Mediterranean Sea; those of Asia, not very far distant from the Indian Ocean; and those of South America, near the Pacific. In the case of each there is a short and rapid slope towards the nearer sea or ocean; a long, gradual slope on the opposite or inland side.

Summary—

There is more land in the Northern hemisphere than in the Southern.

There is more land in the Eastern hemisphere than in the Western.

There are three continents situated wholly to the North of the equator: only one continent wholly to the South of the equator.

There are four continents within the Eastern hemisphere: only two within the Western hemisphere.

The Atlantic shores of either continent exhibit, in general, greater diversity of outline than belongs to the shores of the other great oceans.

Europe has greater diversity of outline (and consequently greater relative amount of coast-line) than either of the other continents; Africa has least diversity in this respect.

The land exhibits, in either hemisphere, two slopes—a long and a short slope. In the Old World the longer slope is from south to north; in the New World it is from west to east.

The highest mountains in the world are the Himalaya chain, in Asia; the next in height are the Andes, in South America.

The following **definitions** must be committed to memory:—

1. **A Continent** is a portion of land so large as to include several countries, or other divisions, as Europe, Asia, &c.

2. **An Island** is a piece of land surrounded by water, as Great Britain, Madagascar, &c.

3. **A Peninsula** is a piece of land nearly surrounded by water, as Italy, Spain and Portugal, the Morea, &c.

4. **An Isthmus** is a narrow piece of land which joins a peninsula to the mainland, as the Isthmus of Corinth, which joins the Morea to the rest of Greece.

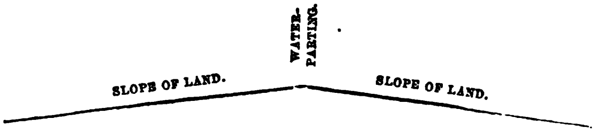
5. **A Plain, or Lowland,** is a portion of land not much raised above the level of the sea, and without any conspicuous elevations on its surface. European Russia is a plain or lowland.

6. **A Highland, Table-land, or Plateau,** is a portion of land raised to a considerable height above the sea. Tibet, in Central Asia, is an example; so also is the interior of Spain.

7. **A Mountain** is a mass of land which rises above the adjacent plain or valley. Sometimes mountains form detached summits, as Mount Ararat, in Western Asia; in other cases they form a continuous chain, or series of chains, as the Alps, Himalaya, &c. Most mountain-chains are the borders of plateaus, or table-lands.

8. **A Defile, or Ravine** is a narrow opening between two adjoining mountains; a valley is a broader opening, with sloping grounds on either side.

9. A rise of land—whether high, or only of moderate elevation—which determines the flow of running water in opposite directions, is called a **Water-parting** or **Watershed.** Thus—



III.

HIGHLANDS AND MOUNTAIN-CHAINS OF THE OLD WORLD.

Plateaus and Mountain-chains are intimately connected, and their linear direction is uniformly the same. They are, in fact, with few exceptions, the terms applied to different portions of the same elevated land-masses. Any extended region of considerable elevation is a plateau or table-land; the external barriers of such a tract of country form, for the most part, mountain-chains. Thus, the Alps form the southward barrier of the Swiss plateau; and the Himalaya Mountains are similarly circumstanced with respect to Tibet.

In general, the highlands of the Old World have their greatest extension in the direction of east and west, and they exhibit a steeper descent to the southward than on their northern face. In other words, they slope more rapidly towards the Mediterranean Sea and the Indian Ocean than towards the Atlantic or the Arctic Ocean. They likewise approach much closer to the waters of the former than to those of the latter, exhibiting a short and rapid slope toward the Mediterranean Sea and the Indian Ocean, a long and gradual descent in the direction of the Atlantic and the Arctic Ocean.

Plateaus.—The principal are—

In Asia.

Tibet	mean	elevation	15,000	feet	above	the sea.
Mongolia	„	„	3,000	do.		do.
The Deccan (India)	„	„	2,500	do.		do.
Afghanistan	„	„	6,500	do.		do.

Persia	mean elevation	3,000	feet above the sea.
Armenia	,, ,,	6,000	do. do.
Asia Minor	,, ,,	3,000	do. do.
Arabia	,, ,,	3,000	do. do.

IN EUROPE.

Central Spain	mean elevation	2000	feet above the sea.
Switzerland and South Germany	,, ,,	1300 to 1600	do.
Southern Norway	,, ,,	4000	do.

IN AFRICA.

The Sahara, or Desert,	mean elevation	1500	feet above the sea.
Abyssinia	,, ,,	6000	do. do.
Southern interior	,, ,,	3000	do. do.

Mountain-Chains.—The principal mountain-ranges of the Old World are :—

ASIA.

Name of Range.	Countries in which situated.	Direction of Chain.	Highest Summit.
Himalaya	India and Tibet	E. and W.	Everest, 29,000 ft.
Kuen-lun	Tibet and Chinese Turkestan	E. and W.	
Thian-shan	Chinese Turkestan and Mongolia	E. and W.	
Altai	Mongolia and Siberia	E. and W.	Bielukha, 11,000 ft.
Yablony, or Stanovoi	Siberia	E. and W.	
Pe-ling	China	E. and W.	
Nan-ling	China	E. and W.	
Hindoo Koosh	Afghanistan	E. and W.	Koh-i-Baba, 18,000 ft.
Taurus	Asia Minor	E. and W.	
Beloor-tagh	Turkestan	N. and S.	
Ghauts	India	N. and S.	
Lebanon	Syria	N. and S.	Hermon, 10,000 ft.

EUROPE.

Name of Range.	Countries in which situated.	Direction of Chain.	Highest Summit.
Alps	Switzerland, Germany, &c.	E. and W.	Mont Blanc, 15,744 feet.
Balkan	Turkey	E. and W.	
Pyrenees	France and Spain	E. and W	Maladetta, 11,426 ft.
Sierra Nevada	Spain	E. and W.	Veleta, 11,389 ft.
Caucasus	European and Asiatic Russia	E. and W.	El-burz, 18,493 ft.
Ural	Do. do.	N. and S.	
Scandinavian Mountains	Norway and Sweden.	N. and S.	Sne-haetten, 8000 feet.
Apennines	Italy	N. and S.	Monte Corno, 9500 ft.

AFRICA.

Name of Range.	Countries in which situated.	Direction of Chain.	Highest Summit.
Atlas	Morocco, Algeria, Tunis	E. and W.	Miltsin, 11,400 ft.
Kong	Guinea	E. and W.	
Nieuw-veld	Cape Colony	E. and W.	

Mountains exhibit great diversity of form, and of course impart corresponding variety of shape and aspect to the valleys which they enclose. Some mountains rise with a steep ascent, exhibiting precipitous sides, while others display gentler slopes, the valley passing by insensible degrees into the hillside, and the hill into the mountain. The summits, again, exhibit in some instances rugged and shapeless masses of rock; in others, a rounded or dome-shaped elevation, or a flattened and table-shaped surface, like a truncated cone. The Table Mountain, at the Cape of Good Hope, is one example of the latter description; and Mount Tabor, in the Holy Land, is another. There are many such in India, their tops crowned with fortresses.

These and other varieties of aspect are intimately connected with the geological structure of the mountain-region—that is, they are consequent upon the kind of rock-strata of which the mountain-mass consists. Every kind of rock formation—granite, trap, (or volcanic rock,) limestone, chalk, and alluvial deposit—has its characteristic external form. Chalk, for example, is uniformly accompanied by the swelling rounded forms which are found in the scenery of Kent, Surrey, and the south-eastern parts of England in general. Deep glens and abrupt precipices, on the contrary, characterise the mountain regions of Wales, Cumberland, and North Britain, where the older and harder stratified rocks are found.

Mountain Passes.—The passes which traverse mountain-chains, and the defiles or ravines by which they are approached, form a noteworthy condition of physical geography, and are highly deserving of study. The passes over the Himalaya Mountains lie at heights of 15,000 feet and upwards; some of those over the Alps reach more than 11,000 feet. The possession of these passes (or *gates*, as they are sometimes termed) has often proved of great importance in warfare, and the feasibility of traversing them is of still greater moment in connexion with the carrying on of commercial intercourse between the nations dwelling upon opposite sides of a mountain-chain.

The Himalaya Mountains belong to the vast series of highland masses which fill great part of Central Asia, and which reach their highest altitude in the lofty plateau of Tibet, 15,000 feet above the sea. The southern face of this plateau constitutes the mountain region, the higher peaks of which attain double the elevation of the plateau itself. The whole length of the Himalaya is 1500 miles, and the breadth of the mountain-mass is from 200 to 250 miles. Along the southern base of the chain, throughout, there stretches a belt of swamp and jungle, called the Tarai, which, during great part of the year, is exceedingly unhealthy. Above this belt, the mountains rise gradually, range above range, with successive terraces between, until at length the region of snow-covered peaks is attained. A vast number of these peaks exceed 20,000 feet, and several are upwards of 24,000 feet. Mount Everest, the highest, is 29,000 feet above the sea. A peak (as yet unnamed) within the north-western Himalaya, and reaching 28,265 feet, comes second in height. Kunchin-jinga, which is third in order of altitude, is 28,156 feet. Dhawalagiri, which comes next, is 26,862 feet.

The snow-line* varies in the Himalaya between 15,000 and 18,000 feet. It is higher on the northern than on the southern face of the mountains, (contrary to what is generally the case in mountain-ranges that are within northern latitudes,) chiefly because of the greater quantity of snow that falls on the southward face of the mountains. Glaciers on a scale of vast magnitude — greatly surpassing the glaciers of the Alps — abound within the higher parts of the mountains.

The Alps fill a like place in the geography of Europe to that taken by the Himalaya in the case of Asia. They stretch, in semicircular shape, round the head of Italy, their middle and eastern portions forming the southern declivity of the plateau of Switzerland and South Germany. The highest summit of the Alps—situated on the border-line of France and Italy—is Mont Blanc, 15,744 feet above the sea ; the second in height is Monte Rosa, 15,158 feet ; the third, Mont Cervin, 14,837 feet. A great number of other peaks exceed 12,000. All the higher parts of the Alps are snow-covered, the snow-line varying between 8000 and 9000 feet in height. Glaciers on a scale of great magnitude occur—the larger of them on the northern or Swiss face of the mountain-region, though a few are found upon the southern or Italian side. The glaciers of the Alps descend the valleys to as low a level as from 3000 to 4000 feet above the sea, their lower extremities being often found in immediate proximity to the vineyard and the cornfield.

The Scandinavian Mountains have some conditions which distinguish them from either of the mountain-regions above-named. The whole of Norway (the westerly division of Scandinavia) is a vast mountain, the western face of which descends with a rapid, in some cases precipitous, slope, into the adjacent ocean. The water penetrates the narrow valleys by which the mountains are there intersected, and forms the numerous *fiords* of the Norwegian coast. The snow-line is found in the southern part of Norway at heights of 4000 to 5000 feet—at a less elevation farther to the northward. There are glaciers of large size within parts of Norway.

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* That is, the line above which snow is always found, in summer and winter alike.

A glacier is an ice-stream, or river of ice, which has its origin in those portions of the mountain-region that lie above the snow-line, and moves slowly, but constantly, down the valley within which it lies. The glacier derives a constant supply (to replace the continual waste which goes on, owing to the thawing of the ice within its lower portion) from the snow which falls with each succeeding season, and most abundantly during the winter. At its lower extremity it is fronted by a mass of loose stone, rock, and various *débris*, derived from the mountain-side during its lengthened course, known as a *moraine*. Where the lower portion of the glacier has melted, the moraine is of course left standing, and marks the limit which the ice had once attained. The pressure of the accumulating mass of ice (or frozen snow) from above, and the downward-tending gravity of the whole, force the glacier onward to a level which is far lower than that at which congelation would originate, until at length the warm temperature of the lower valley causes the ice-stream to melt, and stays its farther progress. The glacier then gives place to a stream of water, which issues from the lower extremity of the ice, and has already flowed beneath the surface, throughout great part of its lower course.

The surface of the glacier is *crevassed*—that is, intersected by deep rents, or crevasses, which are often many hundred feet in length, and of vast depth. These crevasses constitute one of the great difficulties in glacier-travelling. The rate at which the glacier moves is almost infinitely slow as compared with the motion of running water, owing to the partial rigidity of the ice which composes its mass. The average daily motion of the Mer de Glace, (the glacier of Mont Blanc,) has been ascertained to be about 17 inches in summer, but not more than 13½ inches during winter. The aspect of the entire ice-stream undergoes frequent change, from the partial thawing, (and consequent lowering of surface,) which is occasioned by the heat of the summer sun.

There are glaciers in many other mountain-regions, besides those above-mentioned. Glaciers of vast size occur in the chain of the Caucasus. A few of small size occur in the Pyrenees, and also in the Rocky Mountains and the Andes. In the southern island of New Zealand there are glaciers of vast dimensions—larger than those of the Alps.

IV.

HIGHLANDS AND MOUNTAIN-CHAINS OF THE NEW WORLD.

Plateaus.—The principal are—

In North America.

Region lying W. of the Rocky Mountains (Utah, Nevada, British Columbia, &c.)......	mean	elevation—	5,000	feet.
Labrador...........................	,,	,,	2,000	,,
Mexico	,,	,,	7,000	,,
Central America.................	,,	,,	3,500	,,

In South America.

Quito (Andes of Ecuador).......	mean	elevation—	9,000	feet.
Pasco (Andes of Peru)..........	,,	,,	11,000	,,
Titicaca (Peruvian and Bolivian Andes)	,,	,,	13,000	,,
El-Despoblado (Andes of Bolivia and La Plata)............	,,	,,	13,000	,,
Interior Brazil....................	,,	,,	1,500	,,

Mountain Chains.—Nearly all the mountain-ranges of the New World lie in the general direction of N. and S. The only exceptions are found in the mountains of Venezuela and Guiana, (South America,) and in some of the low ranges of hill that cross the plateau of interior Brazil. Some of the most elevated summits of North America, however, consist of detached conical peaks, (of volcanic origin, and many of them active volcanoes,) which rise above the plateau of interior Mexico.

The two principal mountain-systems of North America are —the Rocky Mountains and the Alleghany.

The Rocky Mountains lie towards the western side of the American continent, though at a distance of several hundred miles from the shore-line of the Pacific. They extend from the shores of the Arctic Sea on the N. to the parallel of 30° on the S.—a range of nearly three thousand miles. The middle portions of the chain attain the greatest height, several of the summits lying between the parallels of 33° and 52° being upwards of 13,000 feet in height, and a few points upwards of 15,000 feet. The highest is Mount Brown, 15,900 feet. The higher summits, throughout, rise above the snow-line.

The whole space intervening between the Rocky Mountains and the Pacific Ocean is filled by a series of highlands and mountains, the latter forming in many cases distinct ranges in the neighbourhood of the coast. The chain called Sierra Nevada, which borders the plateau of Utah on the west, reaches above 10,000 feet in height.

The Alleghany Mountains belong to the E. side of North America, and are within the United States. They include a number of parallel ridges, lying N.E. and S.W., and divided by narrow valleys. The average height does not exceed from 2500 to 3000 feet, but the highest summits exceed 6000 feet.

The volcanic peaks which are found in Mexico and the countries of Central America reach a greater height than any of the points among the Rocky Mountains. Thus, the summit of Popoca-tepetl (a name which signifies "smoking mountain") is 17,773 feet above the sea; and Orizava, or Cilal-tepetl ("star mountain,") 17,373 feet. But the base from which these mountains rise is itself several thousand feet above the sea-level, so that their real elevation is much less.

South America includes the Andes, the Mountains of Guiana, and the Mountains of Brazil. The two last-named lie chiefly towards the eastern side of the continent. The Andes, which are the highest and most important amongst the mountain-systems of the New World, are on its western side, and are nowhere far distant from the Pacific.

The Andes extend through the whole length of South America, from the shore of the Caribbean Sea southward to Cape Horn. They include, in general, two (in some parts three and even four) parallel chains, with high valleys and plateaus between. The plateaus of Quito and Titicaca are bordered on either hand by the highest summits of the mountain-system : Chimborazo, Cayambe, Cotopaxi, and other lofty summits› adjoin the former ; Lirima, Sahama, Sorata, and Illimani, are grouped around the latter.

It is usual to divide this vast mountain-system (with reference to the countries through which it extends,) into the Columbian, Peruvian, Bolivian, Chilian, and Patagonian Andes. The mountain called Aconcagua, in the Chilian Andes (on the border-line of Chili and La Plata) is the highest measured summit, and reaches 23,910 feet above the sea. But Lirima, in the Bolivian Andes, is supposed to attain a greater height. The height of the chain diminishes greatly to the southward of Chili, and the mountains finally sink below the sea in the islands of Tierra del Fuego and the adjacent rocks that terminate in Cape Horn.

Since the Andes lie in the direction of N. and S., the height of the snow-line (which varies with the latitude) is, of course, different in different parts of the range. Under the equator, perpetual snow is found in the Andes at 15,800 feet above the sea ; in the Bolivian Andes, the height of the snow-line is still greater, ranging from 16,000 to 18,000 feet. In the Chilian Andes, it gradually declines from 14,000 to 6000 feet. The passes over the mountain-region lie in some cases at heights of 12,000 feet and upwards.

The Andes coincide throughout with a line of volcanic agency. They include a greater number of active volcanoes than any other mountain-regions on the globe, and the countries which they traverse are uniformly liable to shocks of earthquake—sometimes of terrible intensity.

V.

LOWLAND PLAINS.

THE transition from the mountain to the plain or valley, though sometimes abrupt, is more frequently gradual. The lowlands stretch out from the base of the mountains, gradually declining towards the ocean, upon the distance of which their relative slope depends. It is through the lowland plains that the principal rivers have their courses, and they form in many cases the most populous regions of the globe.

Among **lowland plains** are the following—

ASIA.

1. Plain of the Euphrates and Tigris (ancient Mesopotamia and Babylonia.)
2. Plain of Hindoostan, or Northern India.
3. Plain of Pegu (Indo-Chinese Peninsula.)
4. Plain of Siam (do.)
5. Plain of Tonquin (do.)
6. Plain of North-Eastern China.
7. Plain of Siberia.
8. Plain of Turkestan.

The three first-named of the above slope southwardly, and are watered by rivers that flow into the Indian Ocean. The succeeding three are watered by rivers that belong to the Pacific basin. The plain of Siberia slopes northwardly, and its rivers are directed to the Arctic Sea. The last-named region—Turkestan—is an inland depression, its rivers terminating in the Aral Basin.

EUROPE.

1. The Great Plain of Eastern Europe (Russia.)
2. Plain of Northern Germany and the adjacent Low Countries (Netherlands.)
3. Plain of Languedoc, or Southern France.
4. Plain of Andalusia, or South-Western Spain.
5. Plain of Lombardy, or Northern Italy.
6. Plain of Hungary, or the Middle Danube basin.
7. Plain of the Lower Danube (Wallachia and Bulgaria.)

The first-named of the above comprehends half the European continent, extending from the White Sea on the N. to the Black and Caspian Seas on the S., and from the Ural Mountains to the shore of the Baltic. In the latter direction it is continuous with the plain of Northern Germany and the adjacent Netherlands. The south-eastern portions of this region comprehend the **steppes** or grassy plains of southern Russia, which stretch along the shores of the Black and Caspian seas, and thence into the adjoining parts of the Asiatic continent.

The plain of Languedoc coincides in great part with the valley of the river Garonne; the plain of Andalusia, with the basin of the Guadalquivir; Lombardy, with the valleys of the Po and Adige.

The lowland plains of the New World are on a vaster scale than those of the Old World—Siberia alone excepted. The whole interior of both North and South America is a vast succession of lowland plains, watered by rivers on a scale of corresponding magnitude. The rivers supply the readiest means of distinguishing their various portions:—

1. The plain of the Mississippi is the region of **prairies**, or meadows, which occupied, in a natural state, its middle and upper portions, between the Alleghanies and the great lakes on the one side, and the Rocky Mountains on the other. The prairies are in rapid process of being brought under the plough.

2. The plain of the Orinoco is occupied in great part by vast **llanos**, (*i.e.*, levels,) or *savánnahs*, which are grassy regions, many parts of them annually laid under water by the rising of the rivers.

3. The plain of the Amazon is characterised by **selvas**, or forests, which occupy the lower portions of its basin, towards the immediate banks of the great stream and its tributaries.

4. The plains of the La Plata valley (Parana and Paraguay) are known as **pampas** which are grass-covered regions of vast magnitude. Between the estuary of the La Plata and the foot of the Andes, many of the pampas are annually covered with a thick growth of gigantic thistles, intermixed with herbage.

VI.

DESERTS.

MANY regions, some among them of vast extent, are called by the term **desert.** The aspects of these are strikingly various. Some are rocky or stony deserts; others dry, heathy, and gravelly tracts; while some (and those the worst) consist of sandy plains. In some cases, again, the desert coincides with a region of high plateau; in others, with tracts of depressed lowland. The deserts of the Old World are vastly more extensive than those of the Western continents, owing to the greater dryness of the former; since it is absence of water, (and especially of perennial streams,) that gives to the desert its worst characteristics. Wherever running water, or even a perennial spring, is found in the desert, an *oasis* is occasioned. The oasis is a verdant spot in the midst of a surrounding wilderness, the verdure being due to the unfailing supply of moisture.

The most extensive deserts are those of Asia and Africa, which form a vast and nearly continuous belt of the Old World, stretching from the borders of China and Manchooria to the shores of the Atlantic. They are enumerated below.

1. **Desert of Gobi, or Shamo,** in Central Asia. This extends over great part of Mongolia: the Gobi is, for the most part, a region of grassy plain, though sandy tracts occur in some localities. It is exposed, from its elevation, to great extremes of temperature, the cold of winter being terribly severe.

2. **Deserts of Turkestan,** lying E. and S. of Lake Aral. They include the tracts known as Kara-koom, (*black sand,*) and Kizil-koom, (*red sand,*) which are divided by the course

of the river Syr, or Jaxartes; and also the desert of Kharesm, or Khiva, adjoining the course of the river Oxus.

3. **Great Indian Desert.** This includes a large region in the N.W. of India, between the lower Indus and the upper portion of the Ganges valley.

4. **Desert of Seistan,** to the S. and E. of Lake Zurrah, in the south-west part of Afghanistan.

5. **Desert of Mekran,** (Beloochistan,) extending along the shores of the Indian Ocean.

6. **Great Salt Desert of Persia,** including the central and eastern interior of the Persian table-land.

7. **Desert of Mesopotamia,** (Al-Jezireh,) between the rivers Tigris and Euphrates.

8. **Syrian Desert,** embracing the eastern or inland part of Syria, from the Euphrates to the mountain tracts that adjoin the Mediterranean.

9. **Arabian Desert,** embracing great part of Arabia. In the N.W. is Arabia Petræa, (the rocky Arabia,) which includes the Sinai region: the more central region forms the high plateau of the Nejd, which consists chiefly of gravelly plains.

10. **Egyptian and Nubian Deserts,** between the Red Sea and the valley of the Nile.

11. **The Sahara,** or Great Desert of Africa, a vast region stretching across the breadth of Africa, from the valley of the Nile to the Atlantic; in the direction of N. and S. it reaches from the Mediterranean Sea and Mount Atlas to Lake Chad and the valley of the Niger. The extreme dimensions of the Sahara are 3000 miles from E. to W., and from 800 to 1000 miles N. and S.

12. **Kalahari Desert,** in S. Africa, to the northward of the Orange river.

Few, if any, of the above regions are altogether destitute either of vegetation or inhabitants. Scarcity of water, which is found only in a few wells or pools, at long intervals apart, is the worst condition common to all of them, more so in the case of the Sahara than in any of the others. The Syrian and Mesopotamian Deserts are only barren during the season of intense summer heat, exhibiting abundant verdure during other portions of the year.

In the New World there are few large tracts correspondent to the deserts of the Eastern continents. The most noteworthy are: 1. the *Plateau of Utah*, or basin of the Great Salt Lake, to the W. of the Rocky Mountains; 2. the *Bolson de Mapimi*, in the northern interior of the Mexican plateau; and 3. some of the interior plains of the La Plata country, between the river Parana and the Andes, in portions of which there are salt-water lakes, without any outlets.

VII.

RIVERS AND LAKES.

A River is a stream of water flowing through the land, and therefore passing from a higher to a lower region. Most rivers are discharged, ultimately, into the sea or ocean; but some rivers have their final outlet in salt-water lakes, unconnected with the sea. A very small stream of running water is called a rivulet, brook, or torrent. A river which unites its waters with a stream of larger size is said to form an *affluent*, or *tributary*, of the latter.

The *valley* of a river is the tract immediately adjacent to the course of the stream. The term *river-basin* has a more extensive significance: it indicates the whole area of country watered by a river and its tributaries. Thus, the *valley* of the Thames implies merely the low ground through which the Thames flows; but the *basin* of the Thames includes also the valleys of the Cherwell, Kennet, Wey, Lea, and other affluents of the main stream—*i.e.*, the whole tract of country within which the running waters are directed towards the Thames, and are ultimately discharged through its channel.

The rising ground which divides one river-basin from another, and down the opposite slopes of which the water flows in opposite directions, is called the *water-shed*, or *water-parting*. In some instances the water-parting is formed by high mountains; in others, it consists merely of a plain of trifling elevation.

Many rivers, as they approach the sea, divide into two or more branches: the tract of land which these branches inclose is called a *delta*. Thus, we speak of the delta of the

Nile, the delta of the Rhone, Ganges, &c. Other rivers, like the Thames, the Mersey, the Humber, La Plata, &c., form *estuaries* at their junction with the sea.

The **Atlantic Ocean**, with its connected seas and gulfs, receives by far the greater number of the large rivers of the globe. This naturally ensues from the fact that the longer slopes of the land, in the Old and New World alike, are directed towards the Atlantic, or the contiguous basin of the Arctic Sea. In the New World, the Mississippi, St Lawrence, Amazon, Orinoco, and La Plata; in the Old World, the Nile, Senegal, Gambia, Danube, and Rhine, are instances. The Obi, Yenesei, Lena, Northern Dvina, and Mackenzie, belong to the Arctic basin, which is merely an extension of the Atlantic.

Of great rivers belonging to the **Pacific** basin, the most conspicuous examples are the Yang-tsze, Hwang-ho, and Amoor, in the Old World; the Oregon, (or Columbia,) and Colorado, in the New.

Among great rivers that belong to the **Indian Ocean** are the Indus, Ganges, Brahmapootra, Irawady, Euphrates, and Tigris—all on the side of Asia, with the Zambesi, among African streams.

Inland Drainage.—A large area of the Old World is watered by rivers that terminate in salt-water lakes, never reaching the ocean. This region of inland drainage includes the Caspian and Aral basins, with the rivers Volga, Ural, Amoo, and Syr. Two similar (but much less extensive) regions are found in the New World: one of them comprehends the basin of the Great Salt Lake, in North America; the other that of Lake Titicaca, in South America.

The principal **rivers of Europe**, arranged according to the seas into which they flow, are—

Volga ....flows into Caspian Sea (through Russia.)

Danube	**flows into**	**Black Sea**	**(through Germany, Hungary, Turkey.)**
Dniester	,,	do.	**(Austria, Russia.)**
Dnieper	,,	do.	**(Russia.)**
Don	,,	**Sea of Azov**	**(do.)**
Kouban	,,	**Black Sea**	**(do.)**

Ebro	**flows into**	**Mediterranean Sea**	**(Spain.)**
Rhone	,,	do.	**(Switzerland & France.)**
Arno	,,	do.	**(Italy.)**
Tiber	,,	do.	**(do.)**
Po	,,	**Adriatic Sea**	**(do.)**
Adige	,,	do.	**(do.)**
Maritza	,,	**Archipelago**	**(Turkey.)**

Oder	**flows into**	**Baltic Sea**	**(Germany.)**
Vistula	,,	do.	**(Poland and Prussia.)**
Niemen	,,	do.	**(Russia and Prussia.)**
Dwina	,,	do.	**(Russia.)**
Neva	,,	**Gulf of Finland**	**(do.)**
Dal	,,	**Baltic Sea**	**(Sweden.)**

Dwina, Northern	**flows into**	**White Sea**	**(Russia.)**
Petchora	,,	**Arctic Ocean**	**(do.)**

Elbe	**flows into**	**North Sea**	**(Germany.)**
Weser	,,	do.	**(do.)**
Rhine	,,	do.	**(Switzerland, Germany, Netherlands.)**
Meuse	,,	do.	**(France, Belgium, Netherlands.)**
Scheldt	,,	do.	**(France, Belgium.)**
Seine	,,	**English Channel**	**(France.)**
Loire	,,	**Bay of Biscay**	**(do.)**
Garonne	,,	do.	**(do.)**
Minho	,,	**Atlantic Ocean**	**(Spain and Portugal.)**
Douro	,,	do.	**(do. do.)**
Tagus	,,	do.	**(do. do.)**
Guadiana	,,	do.	**(do. do.)**
Guadalquivir	,,	do.	**(Spain.)**

Thames	**flows into**	**German Ocean**	**(England.)**
Severn	,,	**Bristol Channel**	**(do.)**
Mersey	,,	**Irish Sea**	**(do.)**
Clyde	,,	**Atlantic Ocean**	**(Scotland.)**
Shannon	,,	do.	**(Ireland.)**

The principal rivers of Asia are—

Obi	flows into	Arctic Ocean	(through Siberia.)
Yenesei	"	do.	(do.)
Lena	"	do.	(do.)
Amoor	flows into	Pacific Ocean	(Manchooria.)
Hwang-ho	"	do.	(China.)
Yang-tsze	"	do.	(do.)
Choo-kiang	"	China Sea	(do.)
Mekon	"	do.	(Anam, Cambodia.)
Menam	"	do.	(Siam.)
Irawady	flows into	Gulf of Martaban	(Burmah, Pegu.)
Brahmapootra	"	Bay of Bengal	(Assam, India.)
Ganges	"	do.	(India.)
Mahanuddy	"	do.	(do.)
Godavery	"	do.	(do.)
Krishna	"	do.	(do.)
Cauvery	"	do.	(do.)
Tapty	"	Indian Ocean	(do.)
Nerbudda	"	do.	(do.)
Indus	"	do.	(do.)
Euphrates Tigris	"	Persian Gulf	(Turkey.)
Kizil Irmak	flows into	Black Sea	(do.)
Kour Aras	flows into	Caspian Sea	(Armenia, Georgia, &c.)
Amoo, or Oxus	flows into	Sea of Aral	(Turkestan.)
Syr, or Jaxartes	"	do.	(do.)

The principal rivers of Africa are—

Nile	flows into	Mediterranean Sea	(Soudan, Nubia, Egypt.)
Senegal	flows into	Atlantic Ocean	(Western Africa.)
Gambia	"	do.	(do.)
Niger	"	Gulf of Guinea	(Soudan.)
Congo	"	Atlantic Ocean	(do.)
Orange	"	do.	(South Africa.)
Zambesi	flows into	Indian Ocean	(Eastern Africa.)

The principal **rivers of North America** are—

Mississippi	flows into	Gulf of Mexico	(through United States.)
Grande del Norte	,,	Atlantic Ocean	(United States & Mexico.)
St Lawrence	,,	Gulf of St Lawrence	(United States, Canada.)
Nelson, or Saskatchewan	,,	Hudson Bay	(Rupert Land.)
Churchill, or Mississippi	,,	do.	(do.)
Hudson	,,	Atlantic Ocean	(United States.)
Susquehanna	,,	do.	(do.)
Potomac	,,	do.	(do.)
James	,,	do.	(do.)
Mackenzie	flows into	Arctic Ocean	(Rupert Land.)
Coppermine	,,	do.	(do.)
Back	,,	do.	(do.)
Fraser	flows into	Pacific Ocean	(British Columbia.)
Columbia	,,	do.	(do., United States.)
Colorado	,,	do.	(United States.)

The principal **rivers of South America** are—

Amazon	flows into	Atlantic Ocean	(Peru, Brazil.)
Orinoco	,,	do.	(Venezuela.)
San Francisco	,,	do.	(Brazil.)
La Plata	,,	do.	(Brazil, Paraguay, La Plata.)
Magdalena	,,	Caribbean Sea	(New Granada.)
Essequibo	,,	Atlantic Ocean	(British Guiana.)

The principal **river of Australia** is—

Murray	flows into	Southern Ocean	New South Wales, Victoria, South Australia.

Lakes are nearly always connected with rivers; often, indeed, they are merely expansions of a river-bed, due to the peculiar shape of a particular portion of its valley. This, however, is far from being always the case. Most lakes receive one or more streams of running water from adjoining high grounds, and the greater number of them also give issue to a stream. This is the case with the English, Scotch, and Irish lakes, and also with those of Switzerland, Sweden and Norway, European Russia, and Canada. Lakes of this description have nearly always fresh and sweet water. There are numerous lakes, however, which have no outlet or channel of discharge, although many of them receive a constant influx of water through running streams. The Caspian Sea, (which is really a vast lake,) is of this kind; so is the Dead Sea, in Palestine. Lake Urumiyah, in Persia; Lake Van, on the high plateau of Armenia; the Great Salt Lake, west of the Rocky Mountains; and many others, are of like description. The water of such lakes is in nearly all cases salt. The Dead Sea and the Lake of Urumiyah are amongst the saltest bodies of water in the globe.

The largest *fresh-water* lakes on the globe are found in Canada, and the neighbouring United States, viz.:—Superior, Huron, Michigan, Erie, and Ontario—a vast continuous chain of inland waters, of which the river St Lawrence constitutes the outlet. The largest fresh-water lake in the Old World is Baikal, in Siberia, from which the river Angara (an affluent of the Yenesei) issues.

The largest *salt* lake on the globe is the Caspian Sea. Lakes of this description are very much more numerous in the Old World than in the western half of the globe, and are especially so within the high central region of the Asiatic continent.

VIII.

THE OCEAN.

THE OCEAN covers nearly three-fourths of the earth's surface. It forms a vast and continuous body of water, by which the whole of the land is insulated. The great land-masses, however, are so placed as to divide the waters into three great basins, to which the names of Atlantic, Pacific, and Indian, are respectively given. The portions of sea that lie in the direction of either pole are distinguished by the terms Arctic and Antarctic. There are thus five Oceans. The Arctic Ocean, however, may be regarded as an extension of the Atlantic basin, though Behring Strait connects it also with the Pacific. The Antarctic Ocean is connected equally with each of the three great ocean-basins.

The Atlantic Ocean has the form of an immense valley, lying in the direction of north and south, and exhibiting a series of great curves, something in the form of the letter S. In its widest part it is upwards of 5000 miles across. It is distinguished especially by the great number of inland seas, gulfs, bays, and other inlets connected with it, and by the great extent of coast line which it consequently possesses—much greater, relatively, than belongs to either of the other oceans. The Mediterranean Sea, the Baltic Sea, and Hudson Bay, with their various gulfs and offsets, as well as the Gulfs of Mexico, St Lawrence, and Guinea, the Bay of Biscay, the Caribbean Sea, and numerous others, all belong to the Atlantic basin.

The Pacific Ocean is larger than the united Atlantic and Indian Oceans, and covers a larger area of the globe's surface than all the continents and islands together. It is above 12,000 miles across (nearly half the circumference of the globe) in its widest portion, under the line of the equator. The shape of the Pacific is that of a vast circular basin, with high mountain chains bordering, for the most part, its shores. There are no inland seas, properly so called, belonging to it. The China and Japan Seas, with those of Okotsk and Kamschatka, belong to its western and northern sides, and the Gulfs of California and Panama form offsets of its eastern waters.

The Indian Ocean is the smallest of the three great oceans, and differs from the other two in the fact of its being limited by land to the northward. It has two considerable inland seas—viz., the Red Sea and the Persian Gulf—besides numerous bays and smaller extensions, of which the Bay of Bengal is the most important. The Straits of Malacca and Sunda, which connect the Indian Ocean with the China Sea, and Torres Strait, which unites the Indian and Pacific Oceans, are among the most important inter-oceanic channels on the globe.

The *depth* of the sea forms a highly important subject of inquiry. The forms of relief exhibited by the land are continued beneath the waters of the ocean, the bed of which exhibits a like variety of hill and valley, depressed plain and raised table-land. This is proved to be the case by the numerous soundings that have been taken, over vast areas of the ocean, alike in the neighbourhood of the land, and in the deep, open waters, hundreds of miles away from land. The deepest parts of the sea-bottom are at least as much *below* the surface as the highest portions of the land are *above* the same level. Depths of 25,000 feet are found in the North Atlantic, between the parallels of 35° and 40°; and the still greater depth of 27,000 feet has been ascertained in the South Atlantic, west of the island of St Helena. These figures, indicating depression *below* the level of the sea, nearly correspond to the heights of the loftiest mountains *above* the same level.

But the sea covers the vastly larger portion of the globe's surface, and it may fairly be assumed that the extreme depressions of its basin are as much in excess of the highest elevations of the land as the area of the ocean-surface exceeds that of the land-surface—*i.e.*, in the ratio of nearly two to one. A depth of above 46,000 feet (or eight miles and three-quarters) has been reached within the southern half of the Atlantic basin (S. lat. 36° 49′ W. long. 36° 9′.) This last is the greatest depth hitherto ascertained, but it is not unlikely that the immense basin of the Pacific may contain even greater depressions.

The *temperature* of the sea is distinguished by its uniformity —its average, at or near the surface, being generally about the same as the mean temperature of the air in the correspondent parallel, while it undergoes much less variation with day and night, or with the recurring seasons, than the atmosphere does. The temperature everywhere falls with increasing depth, and it seems probable that at very great depths (of several hundred fathoms) a nearly uniform temperature prevails throughout the ocean, in all latitudes.

The *saltness* of the sea is one of its best-known properties, and, as well as its bitterness, is due to the various salts which it holds in solution. Of these salts, muriate of soda (common salt) holds the largest place. The total proportion of saline matter contained in sea-water is from three to three-and a-half per cent.—*i.e.*, estimating any given quantity of water by its density, or weight—about three or three and a-half parts in every hundred consist of particles of salt, which would be left behind if the water were evaporated.*

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* A great deal of the salt used for household purposes in some countries, as in Spain and Portugal, and the Mediterranean coasts in general, is obtained by evaporating the sea-water—admitted for the purpose to shallow excavations in the land (*salines*,) and exposed to the hot rays of a southern sun. Salt is similarly obtained upon some parts of the English coast (Essex, Hants, and elsewhere,) but the vastly larger portion of our supply is derived from the brine-springs and rock-salts of Cheshire and Worcestershire.

The quantity of salt which the sea holds in solution is not everywhere the same. Some seas, like the Baltic, are freshened by the influx of numerous rivers. The Mediterranean, on the other hand, is salter than the ocean.

The *specific gravity* of sea-water is greater than that of fresh water—a natural result of its saltness. Sea-water is hence more buoyant than fresh water, as any one who has bathed in the two may readily have distinguished.. The Mediterranean Sea has a higher specific gravity than the ocean at large, and also greater buoyancy. The Dead Sea (an inland lake, the water of which is intensely salt) is greatly more buoyant than either.

The *colour* of the sea—a pale green in the neighbourhood of the land—becomes more blue with increasing depth, and, in the midst of the great ocean, is of a deep indigo hue. The Mediterranean is noted for the deep blue of its waters. The Red Sea, notwithstanding its name, is blue within its middle and deeper portions; it is only near the shores, among the coral reefs which abound there, that it merits the epithet of "red"—that tinge being imparted to the water by countless abundance of minute animalcules, visible with the aid of the microscope. A like cause accounts for the various shades of colours sometimes observable in parts of the ocean.

Currents.—A continuous movement within the sea—that is, a continued flow of its waters in some given direction—constitutes a current. There are such movements in many parts of the great oceans, as well as in inland seas. A current may be likened to a river, on a scale of magnitude vastly greater than that of even the largest rivers: it is a *stream of the ocean*, as a river is a stream on the land. Currents are of the highest importance to navigators; they accelerate or retard the course of ships, according as the vessel is sailing with or against the ocean-stream.

The main cause of currents is to be found in the differences of temperature which obtain in the surface-waters of different latitudes, due to the various amounts of solar heat received in torrid, temperate, or frigid regions respectively. The warmer the water, the less its density. The colder and denser water of high latitudes has a tendency to sink, and the warmer and lighter water of intra-tropical seas to spread over the surface; in the same way that two fluids of different densities (as oil and water) if placed in one vessel, will ultimately arrange themselves—the heavier at the bottom, and the lighter at the surface, of the vessel in question. A continual flow and reflow in the waters of the globe is thus generated.

Many other causes conspire to influence the direction of currents, and to prevent the waters of the ocean from attaining a condition of rest. The rotation of the earth on its axis is one of these. The various rates of motion which belong to different latitudes modify the direction which the currents would assume were the earth at rest, deflecting them from due north and south, to south-east and south-west, north-east or north-west, courses.* The shape of the land, and the particular form and depth of the ocean-bed, in different localities, are also modifying influences which affect the direction of currents. The greater amount of evaporation in some parts of the sea over other parts requires also to be taken into account: thus, the great evaporation from the surface of the Mediterranean necessitates a constant in-flowing current, through the Strait of Gibraltar, to supply the waste.

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* A point on the earth's surface under the equator moves from west to east more rapidly than a point under the parallel of 10°; a point under the parallel of 10° more rapidly than one under the parallel of 20°, and so on, since the same period of rotation (twenty-four hours) is common to all latitudes. Thus, under the 60th parallel, the rate of axial motion is only half that at the equator: in other words, a point on the earth's surface at the *equator* is carried round in an eastwardly direction at a rate equivalent to 1000 miles per hour (24,000 miles ÷ 24,) while a point under the parallel of 60° has a correspondent movement of only 500 miles per hour. This different rate of eastwardly movement under different parallels influences in an important degree the courses of currents (both of air and water) moving in the direction of the meridian—*i.e.*, from N. to S., or the reverse. A current moving *from the equator towards the pole* sets out with an initial *eastwardly* tendency which is greater than that of the regions through which it passes; its *eastwardly* inclination is thus in continual advance, and its actual direction becomes a compound of its meridional movement and its eastwardly (or axial) tendency—*i.e.*, it becomes N.E. instead of due N. On the other hand, a current moving *from the pole in the direction of the equator* has its eastwardly (or axial) tendency at a rate which is less than that proper to the regions into which it advances; hence it lags, or falls behind the movement proper to the lower parallels, and actually its course becomes, in the northern hemisphere, S.W. instead of due S.; in the southern hemisphere, N.W. instead of due N.

Atlantic.—The principal currents of the Atlantic Ocean are—

1. The *Equatorial Current*, setting from E. to W.
2. The *Brazilian Current*, a branch of the preceding, setting along the coast of Brazil, to the south-westward.
3. The *Guinea Current*, setting from N. to S., along the coast of Western Africa.
4. The *Gulf Stream*, flowing to the eastward, or from S.W. to N.E.
5. The *Arctic or Greenland Current*, flowing from N. to S.

Pacific.—The principal currents of the Pacific Ocean are—

1. The *Equatorial Current*, setting from E. to W.
2. The *Antarctic Current*, setting to the N.
3. The *Peruvian Current*, setting from S. to N.
4. The *Cape Horn Current*, setting to the E.
5. The *Japanese* (*or China*) *Current*, setting from W. to E. and N.E.
6. The *Mexican Current*, setting along the coasts of Mexico and Central America, its direction alternating with the seasons

Indian Ocean.—The principal currents of the Indian Ocean are—

1. The *Equatorial Current*, from E. to W.
2. The *Agulhas* (*or Lagullas*) *Current*, from E. to W.
3. The *Southern Connecting Current*, from W. to E.

It thus appears that the general direction of ocean-currents, within *tropical* latitudes, is to the *westward;* within *temperate* latitudes, to the *eastward.* In the *higher latitudes*, of either hemisphere, the direction is *from the pole towards the equator.*

The Gulf Stream is the most important and powerful of currents. It derives its name from the fact of its origin in the Gulf of Mexico, whence it issues by the narrow channel between the Peninsula of Florida and the Bahama Islands; thence it flows, in a N.E. direction, along the coast of the United States, as far as Cape Hatteras (lat. 35° 13′,) where it strikes off to the E., and afterwards continues, in a general eastwardly direction, as far as the neighbourhood of the Azores, with gradually decreasing velocity of motion. Its farther course is not accurately made out, but a branch of it is generally believed to extend, in a N.E. course, past the western shores of the British Islands and Norway, into the seas lying to the S. and S.E. of Spitzbergen.

The Gulf Stream is distinguished by its superior warmth, as compared with the ocean at large, as well as, in its origin, by the deep indigo hue of its waters, and by the great rapidity of their movement. This rapidity becomes gradually lost, as the stream widens out after its eastwardly course from the coast of the North American continent. It is, however, appropriately called " a river of warm water, flowing between banks of colder water on either hand." It is a highly important agent in modifying climate, communicating its higher temperature to the air in immediate contact with its extensive surface, and carrying combined warmth and moisture to the regions towards which its course is directed—*i.e.*, to the coasts of western and north-western Europe. The moist and comparatively equable climate of the British Islands (and especially of their western shores,) is no doubt due in part to this cause.

The **Arctic current** of the Atlantic, which is also an important and powerful stream, has an opposite influence upon climate. It brings down from Baffin Bay vast quantities of loose floating ice, with huge icebergs, and carries a low temperature to the coast of Labrador and the lands adjoining the Gulf of St Lawrence.

Waves.—The Tides occasion a periodical change in the level of the ocean, high and low water succeeding one another, along lines of sea-coast in general, at intervals of about six hours. The cause of these movements is astronomical: they are due to the attraction exerted by the Moon, (and, in a less degree, by the Sun also,) on the waters of the globe. The tidal wave, however, is materially influenced in its actual direction and rate of movement by the irregular shape of the land, as well as by the depth of the sea, and other conditions. The vast expanse of the Southern Ocean (where alone the waters form a continuous belt around the globe) is the region within which the wave of high water, which twice a-day visits our shores, is derived—travelling with steady (though not everywhere uniform) movement over the intervening seas. Lines drawn so as to connect places which at new and full moon have high water at the same hour, are called *co-tidal* lines. These, however, are only of limited importance in the study of physical geography.

The most frequent cause of disturbance in the surface of the sea is found in the winds, which sometimes raise a mere ripple upon the waters, while at others they lash them into fury, raising the great waves which accompany the storm. The height of waves generated in the open ocean, where there is no obstruction to their onward movement, is much less than in the case of a rocky coast, or pier, or resisting body of any kind. The advancing body of water seems to the mariner (especially when his vessel is within the trough or hollow between two adjacent waves) of vastly greater height than really belongs to it. The average height of the Atlantic waves does not exceed twenty-four feet from trough to crest, or half that elevation above the *mean* level of the waters. The mean highest waves, during a long-continued gale, have been found to reach forty-three feet above the trough of the sea. The interval between successive waves is found, under the same conditions, to be about 600 feet, and their rate of advance equal to thirty-two miles per hour.

IX.

THE ATMOSPHERE.

The air, or atmosphere, is an invisible fluid, which everywhere surrounds the globe, covering land and sea alike; and necessary to the support of life, both vegetable and animal. Amongst its properties is that of density, or weight. Air exerts upon every object a pressure which, at the average level of the sea, is equal to about fifteen pounds to the square inch.* This pressure, however, is not everywhere the same in amount, even at the level of the sea. It becomes gradually lessened with increase of elevation, as the lower and denser strata of the whole body of air are passed through; the amount of pressure is hence always less at the summit of a hill than at its base. In like manner, the temperature of the air undergoes a gradual diminution with successive ascent to its higher strata; and the air at the top of a hill is hence always cooler than at its base. The rate of this progressive decrease does not, however, follow any uniform law.

Anything which sets air in motion renders its presence immediately sensible. When perfectly at rest we are unconscious of its presence, though inhaling (and again expelling) it with every breath we draw; but directly anything imparts motion to the air, we feel the movement, and are rendered conscious of its force. Wind is simply air put in motion. Any contraction or expansion in the volume of air, consequent upon change of temperature, disturbs the equilibrium of the whole body of air, and occasions a wind. Air becomes lighter in proportion as it is warmer; hence, in any body of air, if one portion has its temperature raised, it acquires a tendency to rise, while the cooler and heavier portions of the surrounding air press in to take its place. An ascending current of warm air, and one or more horizontal currents of colder air, are thus generated.

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* The *barometer* measures the varying amount of this pressure, by means of the height to which it supports a column of mercury. The *thermometer* measures the varying heat of the air, in virtue of its property of expansion—the column of mercury in the tube of the thermometer expanding with heat and contracting with cold.

The relative dryness or moisture of the air is also a condition that affects its density, and consequently tends to set its different portions in motion. Any accession of moisture adds to the weight of the air; while any abstraction of its contained moisture lessens its density.

The Winds that occur within the warmer latitudes of the globe are more easy of explanation than those which occur within higher parallels, because of their greater uniformity and steadiness, owing to the intenser conditions of solar heat within and near the tropics. Within some portions of the globe the wind is a constant phenomenon, blowing uniformly (or nearly so) from one quarter of the heavens; in other regions it exhibits a periodical alteration, blowing for half the year from one direction, and for half from another quarter. Elsewhere, again, a condition of almost uniform calm, or absence of wind, prevails.

1. **The Calm Latitudes.**—The space marked on the physical map of the world as the "Zone of Calms," is a narrow belt extending across the Atlantic and Pacific Oceans, in the immediate neighbourhood of the equator. Its breadth averages about six or seven degrees. It lies chiefly (within the Atlantic, wholly) to the northward of the equator, owing to the preponderance of land within the northern half of the globe.

The breadth of this zone undergoes some variation, its limits on either side becoming extended or contracted with the place of the sun to the north or south of the equator. When the sun is in north declination, the influence of its vertical heat upon the northern half of the torrid zone extends the belt of calms several degrees northward of its limit at the opposite season of the year: similarly, when in south declination, the direct solar heat causes this zone to range several degrees farther to the southward. It is therefore in reality an *oscillating* belt, rather than a space confined within the definite limits necessarily given to it upon the map. It is a region dreaded by the mariner, on account of the delays, often very tedious, which it opposes to his progress. But the prevailing calm of this belt is occasionally interrupted by sudden and violent gales, under the influence of which the vessel passes through it, and attains a region where steady and uniform currents of air prevail.

The prevailing calms in the neighbourhood of the equator are a consequence of the nearly uniform heat which obtains within the more central portion of the torrid zone, and where, consequently, there is little disturbance (in so far as temperature is concerned) in the general equilibrium of the air. The Indian Ocean, which is of much smaller dimensions than either the Atlantic or Pacific, and is closed in by land on its northern side, is subject to more various influences, and does not exhibit any defined region of prevailing calm.

2. **The Trade Winds.**—Within certain latitudes of the Pacific and Atlantic Oceans there prevail steady winds, blowing uniformly *from* the eastward—*i.e.*, towards the western quarters of the heavens. These are called, from their importance in connexion with the routes of maritime commerce, *trade winds.* In the northern half of the globe, the trade wind blows in general within the space included between the outer edge of the zone of calms and the parallel of 28° N. lat.: in the southern hemisphere, the parallel of 25° S. lat. marks its more general limit. But the range of these winds, like that of the zone of calms, undergoes some variation, oscillating within several degrees of latitude, farther to the north or south, according as the sun is N. or S. of the equator.

The trade winds blow, in a general manner, *from E. to W.* More strictly, the trade wind of the northern hemisphere blows *from* the N.E.—*i.e.*, it is a N.E. wind : the trade wind of the southern hemisphere blows *from* the S.E.—that is, it is a S.E. wind. These winds extend their influence not merely over the ocean, but over large portions of the adjacent land. In South America the trade wind is felt up the valley of the Amazon to a distance of nearly a thousand miles inland.

The cause of the trade winds is found in the greatly higher temperature of the air within and adjacent to the tropics, as compared with that in higher latitudes. The warm air of tropical regions is *lighter* than that of the regions lying nearer towards either pole ; hence it has a tendency to rise, while the cooler and heavier air of temperate and polar latitudes presses in to take its place. The rotary movement of the earth modifies the direction of the atmospheric currents, in the manner already explained in reference to the currents of the ocean,* converting a movement along the meridian—*i.e*, from N. to S., or from S. to N.—into one which has (in the case of bodies of air advancing from regions of less rapid rotation to those of more rapid motion) a direction to the west of north. Thus, a current of air advancing from the direction of the N. pole towards the equator becomes a N.E. wind ; while a current moving from the direction of the S. pole becomes a S.E. wind.

The warm ascending currents of intra-tropical air, moving respectively towards the poles of either hemisphere, (to replace that set in motion towards the equatorial regions, and so preserve the general equilibrium,) gradually lose their superior warmth and lightness, and afterwards descend to the surface, producing, in their conflict with the superficial currents of temperate latitudes, the prevailing westerly winds of either temperate zone.

3. **The Monsoons** are season-winds, blowing chiefly over the Indian Ocean and its adjacent lands. They, too, are trade-winds, like the currents of air last described ; but, instead of being constant, they alternate in direction with the seasons—blowing for half the year from one quarter of the heavens, and for the remaining half from another quarter. The trade-wind of the Atlantic and Pacific Oceans is a perennial wind ;

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* See page 45, *note*.

the monsoon, or trade-wind of the Indian Ocean, is a periodical wind.

From October to March (*i.e.*, during the winter of the northern hemisphere) a *N.E. monsoon* blows over the northward half of the Indian Ocean, or from the neighbourhood of the equator to the shores of southern Asia, including the islands of the Malay Archipelago and the adjacent China Sea. From April to September, or during the summer months of those regions, the *S. W. monsoon* blows within the same area.

Within a more southward portion of the Indian Ocean (including the coasts of north-western Australia and the coasts of eastern Africa to the S. of the equator) a *S.E. monsoon* blows between the months of April and September, inclusive, *i.e.*, during the winter of the southern hemisphere. During the remainder of the year the wind in the neighbourhood of the Australian coast is a *N.W. monsoon;* while that adjoining the African coast becomes a *N.E. monsoon.*

It hence appears that the monsoon of the winter months, in either hemisphere, coincides in direction with the ordinary trade-wind of the Pacific and Atlantic Oceans; while during the opposite season of the year its direction becomes reversed. This is explained by the influence, during the summer months, of a vertical sun upon the coast-regions of the lands by which the Indian Ocean is closed in upon three sides—to the E., N., and W. The air, intensely heated by the solar rays during the period of summer, rises, owing to its superior lightness; and the cooler currents of air from the adjacent sea are set in motion towards the land, to take the place of the ascending currents.

The change of the monsoon does not occur suddenly, but is attended by violent thunderstorms, with irregular movements of the air. This constitutes the "break-up of the monsoon," after a few weeks of which the wind gradually settles round to the opposite quarter. The monsoons exert a most important influence upon the climate of India and other lands adjoining the Indian Ocean—one monsoon being accompanied by heavy rains, while that of the opposite season is a dry wind.

Land and Sea Breezes.—These are winds which blow alternately, about the hours of morning and evening, from the land on to the adjoining sea, or from the sea over the neighbouring land. They are experienced with most force in tropical lands, but prevail also in localities situated many degrees beyond the tropics, as on the shores of the Mediterranean and other maritime regions lying within the warmer portions of the temperate zone. The land-breeze is the wind which, towards the early morning, blows *off* the shore; the sea-breeze sets in as the hours of evening draw near, and brings *to* the land a refreshing coolness from the adjacent waters.

Land and sea breezes illustrate, on a scale of diurnal change, the operation of the same laws which produce the monsoons within a period of annual change. They are due to the unequal heating of the air over adjacent land and sea, with the hours of day and night. During the hours of sunshine, the land acquires heat more rapidly than the adjacent water, and imparts this excess of heat to those portions of the atmosphere with which it is immediately in contact. The air over the land thus becomes hotter, and consequently lighter, than that over the adjacent water; and the difference becomes strongly marked during the hours of afternoon. The equilibrium of the whole body of air is hence disturbed. The lighter air over the land has a tendency to rise; and the cooler air from above the water presses in to take its place. Hence the sea-breeze, which begins to be felt at (or shortly after) the time when the difference becomes most strongly marked—*i.e.*, a few hours after mid-day, or toward the approach of evening. After sunset, on the other hand, the land rapidly parts with its heat, by radiation, while the temperature of the water remains nearly the same; towards the approach of early morning the land has become colder than the water; and the air over the water is relatively of higher temperature than that immediately above the land. Hence the former acquires a tendency to rise; and the cooler air from the adjoining shore sets seaward, to take its place.

The land and sea breezes are very conspicuous amongst the islands of the East and West Indies, on the shores of Guinea and Senegambia, and the coasts of Australia. Similar winds, alternating from opposite quarters of the heavens, are also felt in many inland districts, as in the valleys of the Amazon and its affluents.

Comparison of the map which exhibits the marine Currents with that which illustrates the Winds will show that the direction of both, within correspondent latitudes, is (in a general sense) the same; and the student will have observed that the explanation of both phenomena is, in great measure, identical. Difference in amount of solar heat, and consequent difference of density, combined with the axial rotation of the earth, are the prime causes which explain currents and perennial winds alike. The geographical distribution of both may be thus stated:—

1. Within the warmer latitudes, the Winds, and also the oceanic Currents, have a general *direction to the westward.**
2. Within middle latitudes, the prevailing Winds, and also the principal oceanic Currents, have a *direction to the eastward.*
3. Within high latitudes, the prevailing direction of Winds and Currents alike is from the poles towards the equator—*i.e.*, from N. to S. in the northern hemisphere, and from S. to N. within the southern half of the globe.

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* Let the student bear in mind that a wind blowing *to* the westward is called an East wind; a current setting in the *same direction* is called a westerly current. The wind takes its distinguishing epithet from the quarter *whence* it blows; the current, from the quarter *towards* which its course is directed.

X.

CLIMATE.

By the climate of a country is meant its comparative warmth, its greater or less abundance of rain and the consequent moisture or dryness of its air, its prevailing winds and other phenomena of the atmosphere, and its consequent salubrity or insalubrity—*i.e.*, its suitability for the abode of man. The detailed study of such conditions belongs to the science of meteorology, but a statement of the general facts regarding climate belongs also to physical geography, and forms one of its most important chapters.

Climate, in so far as temperature is concerned, depends mainly upon the three following conditions:—

1. *Latitude*, or distance from the equator.
2. *Height above the sea-level.*
3. *Distance from the ocean.*

1. **Latitude** determines the angle at which the sun's rays reach the surface, in any particular region, and (according as the mid-day sun is more or less near the zenith) the consequent greater or less amount of direct solar heat which they impart. The countries within the torrid zone include the hottest parts of the globe, because they receive the rays of a vertical sun; those within the temperate zones receive less and less heat with successive distance from the tropics; and the frigid zones have received that epithet because of the still smaller amount of heat communicated by a sun which never attains more than a very moderate height above the horizon, while during portions of the year it is invisible during periods of more than twenty-four hours' duration.*

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* See page 8.

The *respective length of days and nights* has a very important share in the determination of climate, as regulated by latitude, and especially so in the case of countries within high latitudes. At the equator, day and night are of equal duration —*i.e.*, of twelve hours length; and in no part of the torrid zone is the excess *above* twelve hours at one season, or the period *short* of twelve hours at the opposite season, more than seventy minutes. Summer and winter are hence unknown within the tropics, range of temperature being confined within very moderate limits. In the temperate and frigid zones, on the contrary, the days at one season of the year, and the nights at an opposite season, are considerably above twelve hours in length, and the differences become greater with every degree of approach towards either pole. In the latitude of London (51½°,) the longest day is nearly seventeen hours, the shortest only seven hours. Under the arctic and antarctic circles, the longest day is twenty-four hours in duration, while at the winter solstice the sun remains below the horizon for a like period.

As long as the sun remains above the horizon, his rays communicate heat to the earth; during the period of darkness, the ground (by the process called radiation) keeps losing the heat which it had previously acquired. Long periods of continuous sunshine hence favour an accumulation of heat —long periods of darkness produce a contrary effect. The higher latitudes of the globe thus experience alternate extremes of heat and cold unknown within the regions that are within or near the tropics, and the summers and winters of such localities become more and more strongly marked by alternate intensities of temperature. During the long day of the polar summer, marked by a duration of *continuous* sunshine which has no parallel elsewhere, there is, for the time, (in July and August,) an excessive degree of heat; while the prolonged absence of the sun at the opposite season is accompanied by the intense rigour of an arctic or antarctic winter.

It hence follows, as to latitude, that—

The torrid zone is a region of generally high temperature, nearly equal throughout the year.

The temperate zones are regions of diminishing heat, on the average of the year, and with increasing range of seasonal temperature—or, in other words, the summers and winters become more strongly marked with increasing distance from the tropics.

The frigid zones are regions of less temperature on the whole, with a winter of intense severity, contrasted with a brief season of high summer heat.

2. **Elevation.**—Increasing height above the general level of any region is accompanied by gradual decrease of temperature. The air is cooler at the summit of a hill than at its base, and the higher mountains are covered, at certain elevations, with unmelting snows. Plateaus or table-lands, whether of large or small extent, are of course influenced in a similar manner: their elevated surfaces are exposed to like cold influences as the mountain-top, though not always in precisely the same measure. The high plain of Quito (9000 feet above the sea,) the Mexican plateau (upwards of 7000 feet,) the plateau of Tibet (15,000 feet,) and the plateau of Central Spain (2000 feet,) are examples of this. These and similar regions have a temperature which is many degrees colder than that of the low grounds in correspondent latitudes. Upon a small scale, the highlands of Northern Scotland, and such regions as Dartmoor, in the S.W. of England, supply like examples.

Elevated lands, such as the above, generally experience a brief period of high summer temperature, due to their exposure to the full force of the sun's rays at that season. This contrasts with a period of intense cold at the opposite season, when cold winds sweep over their high and exposed surfaces. Hence regions so circumstanced exhibit hot summers and severe winters. The summer heat of Madrid sometimes reaches 110° in the shade, while its winter is excessively cold. Erzeroum, Teheran, Ghiznee, and other Asiatic cities, lying on the high interior plateaus of that continent, supply examples of like extremes of temperature. Quito, on the other hand, though nearly on the line of the equator (and therefore in the very heart of the torrid zone,) has a cool and very equable temperature—the latter condition being due to the sheltering influence of the high mountains which line on either side the elevated valley in which it stands.

3. **Distance from the sea** regulates climate in a very material degree, in consequence of the equalising influence of water on the temperature of the air. The extremes of heat and cold, at opposite seasons, are less in the case of islands than in continental regions; and, generally speaking, maritime regions have more equable temperatures than those lying far inland. The climate of the Polynesian Islands is more equable than that of any other part of the globe, the temperature not varying more than a few degrees throughout the year. Western Europe, bordering on the Atlantic, has a much more equable climate than the central and eastern parts of the same continent. The region of the steppes, in the east and south-east of the Russian plain, is distinguished by the conditions of intense summer heat and corresponding winter cold. The climates of Edinburgh and Moscow (cities in the same latitude) exhibit a striking difference, due to this cause. At Edinburgh, the difference between the average temperature of the summer and winter quarters is less than 19°, while at Moscow it is nearly 49°.

Hence the wide difference which obtains between *continental* and *insular* climates—the former exhibiting extremes, the latter nearly equable in point of heat. Eastern Russia, Mongolia, Africa, and Central Australia, furnish examples of the former, as the Polynesian Islands, Madeira, Tasmania, and (in a less degree) Britain and New Zealand, do of the latter.

The following are among the numerous minor conditions which affect climate, as concerns temperature :—

1. **The direction of mountain-chains,** which may exert a sheltering influence, or the reverse, according as they lie to the N. or S. of any region. Thus, the Alps in some measure shut out Switzerland from the warm influences of the S., while, on the contrary, they protect Italy from the cold winds of the N.

2. **The general slope of the land, which is shown by the** courses of the rivers in any country. This affects a large area of country in the same way that it does a tract of limited extent. A southern or western slope (within the northern hemisphere) is warmer than a northerly or an easterly one.
3. **The nature of the soil,** and the extent to which it has been brought under culture. Gravelly and dry soils tend to raise the temperature; clayey and marshy soils, the reverse. The drainage of the ground, and the clearance of too-extensive forests, generally produce a favourable result upon climate. The destruction of forests may, however, in some cases produce a contrary result, as in the instance of Iceland, which has been rendered colder from this cause.
4. **The direction of prevailing winds,** which are warm or cold, wet or dry, according to the regions they have traversed before reaching any particular district. In Britain, and in Europe in general, N. and E. winds are cold and dry, while S. and W. winds are warm and (especially those blowing from the S.W.) often accompanied by moisture. This is an obvious consequence of the expanse of the Atlantic over which they have passed on their way to our shores.
5. In the case of maritime countries, the **prevailing currents** of the adjacent ocean may have an important influence on climate, in virtue of the conditions stated in a preceding page.*

The names of the following *winds*, which occur in particular regions, deserve to be committed to memory:—

The simoom is the hot wind of the African and Arabian desert. It raises the temperature like the blast of a furnace, producing a heat which is nearly insupportable, and filling the air with sand, which threatens to suffocate those exposed to its influence. In the deserts of Turkestan, this wind is known as the *tebbad* (fever wind.)

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* See page 47.

The sirocco, which is experienced in the S. of Europe, upon the shores of the Mediterranean, is the wind of the African desert, modified by its passage over the intervening waters. The *föhn*, or warm south wind of the Alps, has a similar origin.

The mistral, a cold and dry wind which is experienced on the Mediterranean coast of France, has its origin in the mountain-regions to the north-eastward, and blows down the valley of the Rhone.

The harmattan is a cold and intensely dry wind, which blows from the N.E., during the months of December and January, upon the coasts of Senegambia and Guinea.

The hurricanes of the West Indies, the *tornadoes* and *cyclones* of the Indian Ocean, and the *typhoons* of the China Sea, are rotary storms. They consist of a circular current of air moving with extreme velocity, like the vortex of a whirlpool, the entire current following at the same time an onward track, the path of which follows a curvelinear direction. Within the southern hemisphere, the rotary circle of wind follows the same direction as the hands of a watch (*i.e.*, W. to N., E., and S.;) to the north of the equator, it has an opposite course, as from W. to S., E., and N.

Isothermal Lines.—A line drawn upon the map, or globe, through places that have the same temperature, is called an isothermal line.* Such a line may, of course, be drawn through places that coincide in point of mean annual temperature, or through places that have the same mean seasonal, or monthly, temperatures. The utility of isothermal lines consists in the fact that they render obvious to the eye the important truth, that temperature depends upon many causes besides latitude. Places at correspondent distances from the equator often have widely different climates. The opposite shores of the North Atlantic Ocean present striking examples of this. The mean yearly temperature of Lisbon is nearly as high as that of Charleston (U.S.,) though the latter place is six degrees nearer the equator. London has nearly the same mean annual temperature as Philadelphia, which lies eleven degrees nearer the equator. Edinburgh has a higher annual temperature than Halifax, in Nova Scotia, which is ten degrees nearer the tropic; and Copenhagen is warmer, by several degrees, than St John's, Newfoundland, though the latter place is eight degrees to the southward of the former.

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* *Greek*, *isos*, equal—*thermē*, heat.

Isothermal lines are therefore very far from being coincident in direction with parallels of latitude. They deviate from the parallels to a much greater degree within the temperate and frigid zones than between or near the tropics; because the torrid zone is throughout a region of more nearly equable heat than other parts of the globe. When drawn upon the map of the world, the isotherms of mean annual temperature exhibit convex summits upon the western side of either continent—descending in the direction of the equator in their courses across the interior, and becoming concave in the neighbourhood of the eastern shores, of the Old and New Worlds alike.

Places that enjoy the same amount of *mean annual* heat may, however, experience very different *seasonal* temperatures. Thus, of two places, each with a mean annual temperature of 50°, one may exhibit a difference of only ten degrees between the averages of the summer and winter quarters; in the case of the other, the summer heat may attain an average of 90°, while the winter sinks to 10°. The climates of two places so circumstanced would obviously differ very widely. It is hence instructive to notice the course taken on the map by lines of mean summer and winter temperatures respectively.

In general, the western side of either continent, to the N. of the equator, is warmer by several degrees than the eastern side, and is also more equable in temperature. In similar latitudes, the extremes of heat and cold, at opposite seasons of the year, exhibit a constant increase to the eastward, and become most marked on the eastern shores of the Old and New Worlds alike.

Rain.—The amount of rain-fall at any place is a highly important element in its climate. Rain is very unequally distributed over the globe. In some regions, rain is almost constant, occurring at least within some portion of every twenty-four hours. In other regions, rain only falls at intervals of several years. In many countries, again, the season of rain is limited to a few weeks annually, while during the remainder of the year the air is perfectly dry; in other lands, the rains are distributed, more or less equally, through the whole year.

As general rules, the following laws hold good:—

1. Rain is more abundant in warm than in cold countries, —*i.e.*, the amount of rain-fall diminishes from the equator towards the poles.
2. Rain is more abundant in maritime and insular tracts than in inland regions.
3. Rain is more abundant in hilly than in lowland regions.

Upon the whole, the quantity of rain that falls in the western hemisphere is greater than in the eastern half of the globe. This naturally results from the fact that the extent of oceanic surface is much greater in the former than in the latter, since it is from the ocean that rain is originally derived, by the process of evaporation. Mountains and high grounds in general promote abundant rain-fall, by lowering the temperature of moist and warm currents of air—laden with moisture —which are brought in contact with them by the winds.

Dry and Rainy Seasons.—There are fewer rainy days in the year in warm than in cold countries, although the quantity of rain is greater in the former. In tropical lands, the year is divided into a wet and a dry season, and the rain-fall which occurs during the former period is prodigious in amount—a few hours of rain sufficing to cover whole tracts of country with water, and to convert every rivulet into a raging torrent.

Within the tropics, the rains follow the course of the sun—the season of rain coinciding, upon either side of the equator, with the period of the sun's vertical place in the heavens. Thus, within the northern half of the torrid zone, the period between September and March is the dry season—the sun's place being then between the equator and the southern tropic; the rainy season falls within the opposite half of the year, when the sun is in N. declination. In the southern hemisphere, the seasons of rain and drought are of course reversed.

Within the temperate zones, the period of greatest rain-fall generally occurs within the season of winter. But the respective seasons of rain and drought become less distinctly marked with increasing distance from the tropics.

The total amount of rain-fall within the year is greater in the torrid zone than in the temperate zones, and becomes less with increasing distance from the tropics. But the number of days in the year upon which rain occurs is much greater within temperate regions.

The western hemisphere has generally a greater rain-fall than the eastern. The total amount of rain-fall within the tropical regions of the Old World is said to average 77 inches annually—that in the correspondent regions of the New World, 115 inches. In some tropical localities, the quantity of rain that falls within a few hours equals the rain-fall of the entire year within colder latitudes. The annual rain-fall of London is 24 inches; that of countries lying S. of the Alps, on the Mediterranean border, about 40 inches.

XI.

AGENTS OF CHANGE.

ATTENTIVE examination of the **substances that compose the earth's crust,** (*i.e.*, of all that lies immediately beneath the surface-soil,) shows that they possess great variety. Thus, granite, slate, marble of various kinds, sandstones, coal, chalk, clay, gravel, and sand, are found in different localities, and extending to various depths below the surface. All these substances are designated, in a geological sense, as rocks. Further examination, and comparison of one with another, has led to their division into two great classes, distinguished by the terms *aqueous* and *igneous.* The former have been deposited by the agency of water, (Latin, *aqua,*) and are found for the most part in regular layers, or *strata,* (Latin, *stratum;*) the latter are regarded as due to the agency of fire, (Latin, *ignis,*) and are often found protruded through the superincumbent masses, as though acted on by violent pressure from beneath.

Within the aqueous, stratified, or sedimentary rocks there are found imbedded the fossilised remains of former life; and comparison of the fossils that are found in the various series of strata (chalk, sandstone, &c.) with one another, as well as with the living organisms of the present day, has enabled certain conclusions to be drawn as to their respective ages. Nearly every railway-cutting furnishes an example of rocks of this class.

The igneous rocks, on the other hand, contain no fossils, and sometimes display evidence of alteration in the original constitution of the mass, due to the agency of heat, or of heat and pressure combined. Granite may be taken as the most typical specimen of this class of rocks, but the various forms of *trap*, (basalt, &c.) together with the products of modern volcanic action, as lava, scoriæ, &c., come under the same general heading.

Like **natural agencies** to those employed in moulding the external surface of the globe to its present shape are still in operation, and are continually tending to produce changes in the respective areas of land and sea, in the aspect and comparative elevations of the land, and in the relative depths of the adjacent waters. Rivers are continually wearing down their beds, carrying the earthy particles which they hold in solution down to the sea, spreading the materials which once formed part of the solid ground over the floor of the ocean, in some cases filling up their channels of entrance from the sea, and converting into firm land what had once been deep water. Every little torrent that runs down the hill-side, and wears away its rocky or gravelly bed, contributes to this end. Atmospheric agencies tend to promote a like result; the moisture contained in the air gradually crumbles away even the hardest material exposed to it, and the surface of every mountain undergoes a constant waste from this cause—a waste which is greater in proportion to the moisture with which the air is laden.

Along the line of land and sea, again, there is continual conflict between the two; the base of the cliff often yields to the action of the water, and the masses of rock, undermined, fall into the adjacent sea. The water which, during rain, penetrates crevices in the earthy or rocky masses, promotes a like result, especially when it freezes, and, expanding in the process, sometimes rends off huge masses of cliff. Elsewhere, the sea adds to the extent of solid ground, by the silting-up of estuaries, due to the influence of eddies and currents. Agencies of the description here glanced at have effected, and are still effecting, very considerable changes in the coast-line of Britain, especially along our eastern and southern shores, as well as on the shores of Holland, Germany, and elsewhere.*

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* See, for particular examples, the advanced "Text-book of Physical Geography."

Earthquakes and Volcanic Eruptions.—It is to the agency of subterranean heat, manifested in the *earthquake* and the *volcanic eruption*, that the more violent and striking changes in operation at the present day are principally due.

The *earthquake* is beyond doubt the most terrible of the natural dangers to which man is exposed; without any premonitory warning, the shock, which disturbs the solid ground over vast areas, (giving it, in some cases, an undulating or waving motion, in others, causing an elevation, or else a sudden sinking of the land,) may in a few seconds lay whole cities, with their inhabitants, in ruins. Though seldom of more than a few seconds' duration, the earthquake shock is often repeated, with longer or shorter intervals, during a prolonged period, which may extend over days, weeks, months, or even years. The number of earthquakes that occur annually, throughout the globe, is very great; above three thousand are known to have occurred within the first half of the present century, and upwards of three hundred are recorded within Europe alone, during a term of ten years. Happily, however, by much the greater number are merely slight shocks, not more than one in forty being of such violence as to occasion any large amount of injury to man and his works.

Volcanic eruptions may be regarded as manifesting, in another form, the same deep-seated influence of subterranean heat upon the earth's exterior. A *volcano* * is generally a mountain of conical shape, with truncated summit, and at or near its top a depression, called (from its shape) a *crater.*† From this crater, when the mountain is in eruption, issue volumes of dense vapour, combined with various gases, followed in most cases by intensely-heated sand, stones, masses of rock, or other *scoriæ;* accompanied, in the case of some volcanoes, by a liquid substance called *lava*, which flows over the edge of the crater, and rolls slowly down the mountain-side. Some volcanoes are, for a lengthened period, in frequent (or nearly continual) eruption; in other instances, the subterranean fires remain dormant during a lengthened period, and the eruption is only renewed at intervals of many years' duration. Vesuvius, near the city of Naples, in the S. of Italy, one of the most famous of the European volcanoes, first showed itself in eruption, 79 A.D., when the ashes which it ejected completely overwhelmed and buried the neighbouring cities of Pompeii and Herculaneum. Since that period, its eruptions have been frequent, though with some long periods of intermission. In some countries there are extinct volcanoes, the fires of which have been long burnt out, and in many regions where no active volcanic force now exists, there are found over large areas rocks which must have been the product of former volcanic fires.

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* From the Latin, *Vulcanus*, the god of fire.

† Latin, *crater*, a cup.

Geographical Areas.—The regions in which active volcanoes occur are the same as those within which shocks of earthquake are experienced. They are found, with hardly an exception, in near promixity to the sea, either upon peninsulas and islands, (as is generally the case in the eastern half of the globe,) or within the mountain-chains and highlands which border the Pacific coast of the continent, in the western hemisphere. Three great volcanic circuits, in connexion respectively with the basins of the Pacific, Indian, and Atlantic Oceans, are capable of being marked out upon the map :—

1. **Volcanic Circuit of the Pacific.**—Along the whole western side of the New World, from Tierra del Fuego to the peninsula of Alaska and the neighbouring Aleutian Islands, earthquakes are of occasional occurrence, and active volcanoes are found at intervals. The latter are especially numerous within portions of the Andes, and are also common in the highlands of Central America, and upon the Mexican plateau. Several of the highest volcanoes in the world are found in the neighbourhood of Quito, nearly under the equator.

Upon the western side of the Pacific basin, Kamschatka, the Kurile Islands, Japan, and the entire region of the Malay archipelago, display similar conditions. The prolongation of the volcanic chain to the southward of the Philippine and Moluccas groups is seen in the New Hebrides, again in New

Zealand, and, much farther S., in the distant land known as South Victoria, where Mount Erebus is found discharging its fires within a few degrees of the southern pole. The detached volcanoes of the Sandwich, Friendly, Society, and Marquesas groups, belong to the same region.

2. **Volcanic Circuit of the Indian Ocean.**—Active volcanoes are numerous throughout the great island region which intervenes between the Pacific and Indian waters, and nowhere more so than in Java, where they range in a direct line from the eastern to the western extremity of the island. The volcanic chain of Java is prolonged to the eastward through the Lesser Sunda Islands, (Sumbawa, &c.,) in which direction it is united with that which borders upon the Pacific. Barren Island, in the Bay of Bengal, exhibits an extension of the chain to the northward. The Red Sea exhibits the same conditions upon some of the islands within its basin, as well as on its western shores. The island of Mayotta, (Comoro group,) Réunion or Bourbon Island, and the hot springs of St Paul and Amsterdam, in high southern latitudes, are points which indicate the continuity of the volcanic chain, while earthquakes (often of great violence) are experienced within the lands that border the Indian Ocean to the northward.

3. **Volcanic Circuit of the Atlantic.**—The S.W. portions of Asia, the S. parts of the European continent and its adjacent islands, with the N.W. parts of Africa, fall within this region upon one side, as the islands of the West Indies do upon the other. The circuit of the Mediterranean (around nearly the whole of which earthquakes are experienced) is included within its limits. To the northward, the numerous volcanoes of Iceland, and the more distant cone of Jan Mayen Island, fall within the Atlantic area, together with the volcanic peaks of the Azores, the Cape Verd, and Canary groups. In the opposite direction, the Camaroons mountain, adjoining the upper extremity of the Gulf of Guinea, is an outlying member of the same region.

Active Volcanoes.—More than 300 active volcanoes are known. A few of the more important, within either hemisphere, are included in the following list:—

WESTERN HEMISPHERE.

	Height in feet.
Gualatieri (Andes)	21,960
Arequipa (do.)	20,320
Antisana (do.)	19,137
Cotopaxi (do.)	18,877
Tolima (do.)	18,026
Popocatepetl (Mexico)	17,773
Orizava (do.)	17,373
Tunguragua (Andes)	16.579
Toluca (do.)	15,271
Erebus (S. Victoria)	12,400
Kilaueh (Sandwich Islands)	3,970
Cosiguina (Central America)	1,000

EASTERN HEMISPHERE.

	Height in feet.
Kliuchevsk (Kamschatka)	16.512
Camaroons Mountain (W. Africa)	13,129
Slamat (Java)	12,300
Indrapura (Sumatra)	12,300
Tomboro (Sumbawa Island)	7,600
Teneriffe (Canary Islands)	12,236
Fusi (Niphon: Japan)	12,000
Etna (Sicily)	10,874
Piton de la Fournaise (Réunion)	7,200
Beerenberg (Jan Mayen Island)	6,870
Hekla (Iceland)	5,095
Vesuvius (Italy)	3,932

Coral Islands exhibit another form of change, of altogether distinct nature to the above, but in virtue of which a continual addition is making, within certain regions of the globe, to the area of habitable land. They are due to the labours of the coral-worm, which, basing its labours upon submarine reefs, lying at a moderate depth, (probably seldom more than twenty or thirty fathoms,) keeps building upwards towards the surface, continually adding to the extent of the hard stony secretion in the interstices of which it dwells. When the surface is once reached, its labours in a vertical direction cease, but the lateral extent of the reef continues to increase, and with most rapidity in the direction most exposed to the force of wind and sea, *i.e.*, upon the windward side of the reef or island. A vast number of the Pacific Islands, as well as the Maldive and Chagos groups in the Indian Ocean, with the Bahama Islands, and the little group of the Bermudas in the Atlantic, are of coral formation. The Bermudas, which are in 32° 20′ N. lat., are farther distant from the equator than any other coral reefs, since the coral-worm requires a high temperature; coral is only found, tenanted by its living architects, within tropical or sub-tropical seas.

XII.

NATURAL PRODUCTIONS OF THE EARTH—MINERALS.

Coal takes the first place in order of importance to man amongst the productions of the mineral kingdom. It is, happily, of exceedingly wide distribution, the beds in which it occurs, in workable condition, being found in widely-distant regions of the globe. They are nowhere worked to so abundant an extent as in Great Britain, the annual coal-produce of which is at least two-thirds of the total produce of the globe—*i.e.*, the quantity of coal furnished by the mines of Britain is more than twice as great as that of all other coal-mines in the world taken together!

Coal is known to exist in the following regions:—

Europe.—Great Britain and Ireland, Belgium, France, Germany, Hungary, Spain, Russia, Sweden.

Asia.—India, China, Japan, Persia, Syria, Asia Minor, Burmah, Malay archipelago (Labuan Island.)

Africa.—Valley of the Zambesi.

America.—United States, New Brunswick, Cape Breton I., Prince Edward I., Vancouver I., Greenland, Cuba, Chili.

Australia, &c.—New South Wales, Tasmania, New Zealand.

The total area of the British coal-fields is less than 3000 square miles. Belgium, the coal-fields of which are little more than 500 square miles, supplies the next largest quantity to Britain. The coal-fields of the United States have an area of nearly 200,000 square miles, above seventy-fold that of the British coal-fields, but they are at present only worked to a very limited extent, compared with their vast capabilities. They fall principally within the states of Pennsylvania, Ohio, Western Virginia, Illinois, Michigan, and Missouri.

Iron is even more widely distributed than coal. There are few countries in which iron does not enter, in one form or other, into the mineral composition of rocks. In Britain, the carboniferous beds are the seat of the most extensive iron produce; but iron is by no means confined to those localities. The quantity of iron furnished annually by Great Britain exceeds four and a quarter million of tons, which more than equals the produce of all other countries unitedly.

The principal countries in which iron is worked are—

Europe.—Great Britain and Ireland, Belgium, France, Russia, Germany, Sweden and Norway, Italy, Spain.

Asia.—Asia Minor, Georgia, Armenia, Persia, India, Siberia, Japan, Malay archipelago.

Africa.—Algeria and Atlas region in general, Zambesi valley, Cape Colony, Natal.

America.—United States, Canada, New Brunswick, Nova Scotia, Cape Breton I., Brazil, New Granada, Bolivia, Chili, La Plata.

Australia, &c.—New South Wales, Victoria, Tasmania, New Zealand.

Copper is worked to a large extent in Britain, (chiefly Devon and Cornwall,) but is supplied in larger quantity by Chili, Cuba, and South Australia. The countries in which it chiefly occurs are—

Europe.—British Islands, Spain, Russia, Hungary, Sweden and Norway, Turkey, Germany.

Asia.—Asia Minor, Armenia, Siberia, India, China, Japan, Persia, Malay archipelago.

Africa.—Algeria, Zambesi valley.

America.—Canada, Rupert Land, Cuba, Chili, Peru, Bolivia.

Australia.—South Australia.

Tin, a valuable and rare metal, is derived chiefly from the mines of Cornwall, and from the island of Banka (lying east of Sumatra,) in the Malay archipelago. It occurs also in Spain, (province of Galicia,) and Bohemia; likewise in Burmah, Assam, the Malay peninsula, and some of the other islands of that region; also in Mexico, Peru, and Australia (Victoria.)

Lead occurs most abundantly in the following countries:—

Europe.—Spain, Great Britain and Ireland, Germany (Carinthia, Bohemia, &c.;) Hungary, Transylvania, France, Belgium, Norway, Portugal, Turkey. The mines of Carinthia are of very high value.
Asia.—Siberia, Armenia, India, China, Siam, and Japan.
Africa.—Atlas region (Algeria.)
America.—United States, Canada, Chili, Peru, Bolivia, La Plata.
Australia.—South Australia, Western Australia.

Zinc is derived chiefly from England and Wales, Prussia, and other parts of Germany, Belgium, Spain, the United States, China.

Quicksilver, or mercury, is a metal of limited distribution. The most valuable sources of supply are the mines of Idria, (in Carniola, a province of Austrian Germany,) and those of Almaden, in Spain (La Mancha,) within the Old World. China and Japan also furnish this metal. In the New World, Peru, and within a recent period California, are the chief regions where quicksilver is derived.

Gold.—The discoveries of recent years have shown that this metal is of much more extensive distribution than was formerly supposed. The gold-fields of California (discovered in 1848,) and those of Australia (first worked in 1851,) have far surpassed any others in richness of produce, and have together supplied upwards of £20,000,000 sterling annually,—a vastly greater quantity than that derived from any other region, or from all other regions united. The Siberian gold-mines come next in amount of annual produce.

The principal sources of supply for native gold are:—

Europe.—Transylvania, Hungary, Italy, Spain, Wales, Ireland (Wicklow mountains.)

Asia.—Siberia, Tibet, China, Burmah, Siam, Malay peninsula and archipelago (Borneo, &c.,) Cochin-China, Tonquin, Japan.

Africa.—East and West coasts, within the tropics; interior Soudan.

America.—United States (California,) British Columbia, Mexico, Central America, Brazil, New Granada, Bolivia, Chili, La Plata.

Australia, &c.—Victoria, New South Wales, New Zealand.

Silver is supplied, in a native state, chiefly by the following countries:—

Europe.—Hungary, Transylvania, Germany (Bohemia, Saxony, Hanover, &c.,) Turkey, Norway, Spain, England.*

Asia.—Siberia, China.

America.—Peru, Mexico, Bolivia, New Granada, Chili, La Plata.

Platinum, a valuable and scarce metal, in extensive usage in Russia, is derived chiefly from the Ural Mountains. It occurs also in Brazil, New Granada, and Spain.

The above comprehend only a few of the principal metallic and mineral substances. Amongst those that rank next in importance are—

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* In combination with lead, with which silver is nearly always in greater or less quantity associated.

Bismuth, (employed chiefly as an alloy, in making pewter, &c.,) which is derived chiefly from Saxony; also found in Siberia and Cornwall.

Antimony, (of like usage, especially in the manufacture of type-metal,) supplied chiefly by France and Hungary; also Spain, Britain, and the province of Sarawak, in the island of Borneo.

Manganese, worked in Devon and Cornwall; also Germany, Hungary, and France.

Nickel, worked in Germany, (Saxony, Bohemia, &c.,) France, and Cornwall.

Cobalt, derived from various ores, found in Spain, France, various parts of Germany, (Saxony, &c.,) and Cornwall.

Arsenic, derived chiefly from Germany, (Saxony, and the Harz regions,) Hungary, Transylvania, Siberia, France, Cornwall.

Sulphur, a combustible mineral, is derived chiefly from Sicily; and also occurs abundantly in Spain.

Graphite, or **plumbago,** (erroneously called black-lead,) occurs in Siberia, Norway, and other countries, but is chiefly derived from the high valley of Borrowdale, in the mountain district of Cumberland.

The **diamond** is in the present day found chiefly in Brazil; also, though to a much smaller extent, in India, Borneo, and the Ural Mountains.

Of other precious stones—

The *emerald* is derived chiefly from Peru, and the neighbouring parts of S. America.

The *ruby*, from Burmah and Ceylon.

The *amethyst* and *topaz*, from Ceylon and China.

The *turquoise*, *amethyst*, *jasper*, *topaz*, *cornelian*, and several others of less value, from India, Turkestan, Tibet, Siberia, also the mountain districts of Russia, Hungary, Transylvania, &c.

Salt occurs, as a solid mineral, over vast areas of the globe, besides its presence in a state of solution throughout the vast ocean, as well as in many inland seas and lakes. Portions of the steppe region, in the S.E. of Europe, the tract known as the Great Salt Desert (Persia,) and large areas in the western half of the African Sahara, exhibit inexhaustible quantities of this mineral. In Britain the chief supply of salt is derived from Cheshire and Worcestershire, within the area of the formation known to geologists as the new red sandstone, the finest description being the produce of brine-springs. The salt mines of Bochnia and Wielicza, in Austrian Poland, or Galicia (E. of Cracow,) are worked on a vast scale. Upon the coasts of Spain, Portugal, southern France, and other warm regions, as well as, to a very much smaller extent, upon parts of the English shores, salt is obtained, by evaporation from the sea-water, admitted for the purpose into shallow excavations or salines.

XIII.

NATURAL PRODUCTIONS OF THE EARTH—PLANTS.

THE **geographical distribution of vegetable life** is in great measure regulated by conditions of soil and climate. The great essentials to the growth of plants are *light, heat*, and *moisture*, and the various proportions in which these are combined, in the instance of any particular locality, determine its suitability for the development of any particular description of tree, fruit, flower, vegetable, or plant of any kind. Speaking generally, vegetation is most luxuriant within tropical regions, (under the combined influence of heat and moisture,) and diminishes in variety and abundance with increasing distance from the equator. The increasing inequality in the lengths of successive periods of light and darkness, which is proper to high latitudes, and which becomes greatest within the polar circles, is accompanied by obvious peculiarities in the classes of plants that are native to such regions.

Elevation, as well as *latitude*, affects the growth of plants. In this respect a high mountain within the torrid zone supplies an example of the conditions that belong to an entire hemisphere. The luxuriant vegetation of the tropics, which flourishes around its base and for a moderate distance up, gradually gives place to hardier forms of life. These become dwarfed as the cold region of the mountain-top is approached, and at length only creeping plants, such as mosses and lichens, are found, while all sign of vegetation disappears with the presence of perennial snow.

Zones of Vegetable Life.—In so far as influences of climate are concerned, a division of the earth's surface into the following zones serves to express some important truths :—

1. A zone of *Palms and Bananas,* with Tree-ferns, Sugar-cane, Bamboo, Coffee, Cocoa, and various Spices. This zone stretches from the equator to from 15° to 20° upon either side—its exact limits, however, varying with the conditions of particular regions in respect of climate, and its northern limit being for the most part farther distant from the equator than its boundary in the opposite direction.

2. A zone of *Evergreens,* with Fig, Olive, Vine, Orange, and also Cotton and Indigo. In Asia the Tea-plant belongs to this zone, which reaches from about the latitudes of 15° or 20° to the parallel of 40° in the northern hemisphere, and to that of 35° on the south side of the equator.

3. A zone of *Deciduous Trees,*[*] with Wheat and other cereals, also Hemp and Flax. This zone reaches in general from the mean parallel of 40° to that of 55° in the northern hemisphere, and from the parallel of 35° to that of 48° to the south of the equator. The fruits and vegetables of temperate climates flourish chiefly within this belt.

4. A zone of *Conifers*[†] *and Edible Berries,* with the hardier grains (Barley and Oats.) The zone reaches, in the northern hemisphere, from the mean parallel of 55° to the Arctic circle, and, in the case of the western shores both of the Old and New Worlds, to several degrees beyond that line.

5. A zone of *Mosses and Lichens,* with dwarf Shrubs and Alpine Plants, reaching northward from the Arctic circle towards the pole.

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[*] Deciduous plants are those that cast their leaves annually. Latin, *decidere,* to fall.

[†] Trees of the pine and fir tribe, from the conical form of their fruit, of which the common fir-apple is an example.

Botanical Regions.—It is, nevertheless, a well-known fact that each region of the earth has plants peculiar to itself, and that portions of either hemisphere which correspond in the general conditions of climate are distinguished by widely different forms of vegetation. Whole families of plants which are native to certain countries in the northern half of the globe are absent from the correspondent latitudes on the south of the equator, where totally distinct forms take their place; and like differences obtain between the plants that are native to the Old and New Worlds respectively. Even where the same families (*genera*) are represented, the particular kinds (*species*) are nearly always different. In other words, each portion of the globe has its own distinct *flora*, and certain well-defined botanical regions, each distinguished by typical forms of vegetable growth, can be marked out upon the map of the world.

The food plants in most extensive usage supply examples of the above truth. *Wheat*, *barley*, *rye*, *oats*, and *rice* are native only to the Old World, though they have all been transplanted by man to the countries on the west of the Atlantic, and are now extensively grown in America, as well as (with the exception of rice) in Australia, where they were similarly wanting. *Maize*, on the other hand, is native only to America, though now grown in many parts of Europe and Asia.

The *potato*—now of perhaps wider distribution than any other food-plant—is a native of the New World, and was unknown to the people of other lands until the middle of the sixteenth century. The same is true of the *tobacco-plant*, which has became diffused over the greater part of the globe. The *mandioc*, or cassava-plant, which supplies the principal food of the South American Indians, is another of the indigenous productions of the New World, wanting in other lands. The family of trees known as *cinchona*, from which quinine is derived, is naturally confined to South America, though recently transplanted to Southern Asia.

The *tea-plant*, native only to south-eastern Asia, is another example. The *coffee-shrub* was originally limited to the tropical belt of the Old World. The *cacao* (or cocoa) tree belongs only to the correspondent portions of the American continent. The *bread-fruit tree* is the characteristic produce of the islands of the Pacific (Polynesia.) The *date-palm* belongs to the warm belt of the Old World—chiefly to the heated plains of south-western Asia, and the northern half of the African continent—the *cocoa-nut palm* to the western coasts and islands of southern Asia, and the adjacent region of the Malay archipelago.

Changes Effected by Human Agency.—The distribution of plants undergoes great changes at the hands of Man, who carries with him in his migrations the germs of whatever can be profitably cultivated in his new home, and derives *from* other regions whatever productions are likely to flourish under the conditions of soil and climate that distinguish his native land. It is thus that the wheat and other cereals, with numerous fruits, of the Old World have been exchanged for the maize, potato, tobacco, and cinchonas of the New. And in like manner the grains and fruits of southern and western Europe have been carried to Australia, and found to thrive in a region which has fewer food-plants of its own than any other division of the earth.

The *geographical distribution of the principal food-plants*, with a few others that are of high value to mankind, is stated in the following table:—

Wheat, Barley, Rye, and Oats, are natives of the Old World, and all but the last named were probably derived originally from Western Asia. All of them are now cultivated within those portions of the New World that possess a suitable soil and climate. Wheat is also of very extensive culture in Australia.

Rice is also a native of the Old World, and is the chief food-plant of Southern Asia. It has long been extensively cultivated in parts of the North-American continent.

Millet (of which there are several species—some of them extensively used as food) is native to the Old World. The best known kind is the dhourra of Egypt (Nubia.) It has been introduced into the West Indies, where it is known as guinea-corn.

Maize, or Indian corn, is the chief native food-plant of North America. It is now largely cultivated in the countries of central and eastern Europe, and also in parts of Australia.

Cassava or Mandioca, is prepared from the root of the *jatropha manihot*, a plant which is indigenous to Brazil, Guiana, and the neighbouring part of South America, whence it extends into the Mexican isthmus. Tapioca is a kind of starch prepared from the same root.

The *Potato* is native to both divisions of the American continent, whence it has become distributed over nearly the whole globe. Within the tropics, however, it requires a considerable altitude to neutralise the effects of too great heat.

The *Yam* is a native of the Old World—most abundantly found within Southern and South-eastern Asia. It has become extensively introduced into the West Indies.

The *Arum*, or taro, is a native of the Polynesian groups, from the Sandwich Islands to New Zealand. The *Batata*, or sweet-potato, belongs to the same region.

Arrow-root, which is prepared from the root of a herbaceous plant, is a native of South America, whence it has been transplanted to the West Indies, the Bermuda group, and parts of Southern Asia.

The *Banana* and *Plantain*, varieties of the same plant, are native to the tropical regions of the New World, flourishing throughout a zone (of either hemisphere) within which the mean annual temperature is not lower than 75°.

The *Bread-fruit tree* is a native of the islands of the Pacific Ocean, within warm latitudes, and has been transplanted thence to the West Indies. Its fruit supplies the chief article of food to the natives of Polynesia.

The *Cocoa-nut palm*—one of the most valuable of the numerous trees belonging to the palm tribe—is native to the warm and watered regions of both hemispheres. It abounds especially upon the islands and maritime regions of Southern Asia, and throughout the Polynesian Islands.

The *Date-palm* is indigenous to the warm and arid regions of the Old World, its range extending from the region of the Atlas to the plains of India. Dates are extensively used as food by all the nations of Northern Africa and the South-western parts of the Asiatic continent. The date-palm flourishes in Sicily, and on the rock of Malta.

The *Sago-palm* is a native of south-eastern Asia, and is especially abundant in Celebes, the Moluccas, and adjacent islands. The pith of this tree constitutes the sago of commerce.

The *Pandanus*, or *Screw-palm*, which yields a juicy aromatic fruit, is a native of the Caroline Islands (Polynesia).

The *Tea-plant* is indigenous to China, Tonquin, Cochin-China, and Japan. Its range within the first-named country (whence nearly all the tea of commerce is derived) is restricted to the south-eastern provinces, between the parallels of 23° and 318, embracing Fo-kien, Kiang-su, and Che-kiang.

The *Coffee-plant* is a native of Abyssinia, whence it became early naturalised in south-western Arabia (Yemen.) It has been introduced into the New World, from parts of which (Cuba, Brazil, Guiana, and Central America) coffee is now largely derived.

The *Cacao-tree* (cocoa and chocolate of commerce) is a native of South America, the region of the Amazon being its principal seat. It is also found within the Mexican isthmus.

The *Sugar-cane* is a native of China, Cochin-China, and the adjacent parts of south-eastern Asia, whence it has been carried to the New World, where, however, the same plant appears to exist in a wild state.

The *Cotton-plant*, of which there are several species, is indigenous to southern Asia and Africa, as well as to the New World, where it has been more largely grown than in any other region. It has been introduced with success into Eastern Australia (New South Wales and Queensland.)

Flax (the stem of which furnishes the fibre known by that name) is a native of the temperate regions of the Old World. *Hemp* belongs to the same, or nearly the same, localities.

Indigo, of which there are several species, is found growing wild in many parts of Asia and Africa, as well as within the warm latitudes of the New World.

The *Cinnamon-tree*, the bark of which constitutes the cinnamon of commerce, is indigenous only to Ceylon. Other trees belonging to the same genus, but of different species to the true cinnamon, occur in parts of south-eastern Asia and the islands of the Malay archipelago.

The *Clove* is a native of the Molucca Islands, and peculiar to that region. Its culture has been introduced into the island of Réunion, or Bourbon.

The *Nutmeg-tree* is also indigenous to the Moluccas, but is found in several other parts of the East Indies, (Sumatra, &c.) It has been introduced into the Mauritius. The nutmeg of commerce is the kernel contained within the fruit of this tree; the spice known as *mace* is the membranous covering which immediately encloses the kernel.

Ginger is a native of south-eastern Asia and the adjacent islands. It was early introduced by the Spaniards into the New World, and is probably indigenous also to that side of the globe. It is extensively cultivated in Jamaica and other parts of the West Indies. The tuberous root of the plant supplies the ginger of commerce.

Pepper, of which there are numerous species, is found in every quarter of the globe excepting Europe. Both black and white pepper are the produce of the *piper nigrum* of botanists—a perennial plant, found native in India and the Indo-Chinese peninsula, and especially abundant on the Malabar coast. It is largely cultivated in Sumatra, Java, and the neighbouring islands.

Pimento—the allspice of commerce—is supplied by the berries of a tree (*myrtus pimenta*) native to South America and the West Indies, and extensively cultivated in Jamaica.

XIV.

NATURAL PRODUCTIONS OF THE EARTH—ANIMALS.

Geographical Distribution of Animals.—Every great region of the earth has its peculiar forms of animal life, alike in the case of land animals and the tenants of the air or the water. The quadrupeds, birds, reptiles, and insects that are native to the Old World differ from those that are native to the American continent; and those that are found in a native state within the northern hemisphere are generally absent from the corresponding latitudes to the south of the equator. Australia—the only one of the continents that is wholly within the southern half of the globe, and is cut off by surrounding seas from contact with other lands—has a zoology which is wholly unlike that of any other part of the globe.

Striking examples of this truth are supplied by well known and popular instances in the case of the domestic animals. The horse, ass, ox, and common sheep, were all unknown in America until after the time of Columbus, when they were carried across the Atlantic by the Spaniards; and a century has not yet elapsed since the same animals were first introduced into Australia. The elephant, hippopotamus, and rhinoceros, the camel, antelope, and giraffe, the lion, tiger, leopard, panther, and hyena, are natives only of the Old World. On the other hand, the puma and jaguar (the lion and tiger of the New World) are confined to the forests of tropical America; and the kangaroo is only found within the Australian wilderness.

Like differences exist in the case of birds, reptiles, insects, and indeed in all the forms of animal life. The bird of paradise, the gold and silver pheasants, and the peacock, are confined to the eastern hemisphere; the true humming-birds are found only in the western half of the globe. The brilliantly-plumaged parrots and cockatoos of either hemisphere are distinct from one another in species (and, in most cases, in genus;) and the vulture of the Old World is replaced by the condor of the New.

These differences are independent of mere climate. The animals of distant lands, carried by man from one region to another, are found in numberless instances to thrive equally in their new home as within the range of their native pastures. The course of exchange between the native life of the Old and New Worlds has been in progress ever since the days of early Spanish settlement beyond the Atlantic. Horses and oxen are now reared in vast abundance in the plains of South America. One of the most valuable gifts of the New World to the Old has been the turkey—the only one of the domestic poultry that is not indigenous to the eastern hemisphere.

All the larger land animals, as well as some that are inhabitants of the water, are included by naturalists within the class *mammalia* (animals that suckle their young.) The geographical distribution and range of some of the most familiarly known amongst this great division of the animal world are shown on the map;* as, similarly, is the geographical distribution of some of the principal birds and reptiles. The mammalia are divided into the *orders* designated — 1. Carnivora (*flesh-eating*, as the lion, tiger, dog, &c.;) 2. Ruminantia (animals that *chew the cud*, as the camel, ox, sheep, &c.;) 3. Pachydermata (*thick-skinned*, as the elephant, horse, &c.;) 4. Rodentia (*gnawing*, as the beaver, squirrel, rat, mouse;) 5. Edentata (*toothless*, as the ant-eater and armadillo;) 6. Quadrumana (*four-handed*, as apes and monkeys;) 7. Cheiroptera (*winged-armed*, as bats;) 8. Marsupialia (*pouched*, as the kangaroo and opossum;) 9. Cetaceæ (whales and dolphins; Lat. *cetus*, a whale.)

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* Maps Nos. 10 and 11, "Physical Atlas for Beginners."

Europe exhibits in its native zoology a less distinctive character than is the case with other continents—a result due to its immediate contact with the vast continent of Asia, whence most of its forms of animal life have been derived. Many of the animals once found within the forests of Europe have been exterminated, or greatly reduced in number, while others have been so altered by generations of domestic training as to have their characteristics greatly modified. The wolf, bear, and wild boar have been entirely banished from the British Islands; though still found in various parts of the continent. The beaver, once common on the banks of British streams, has long since disappeared. The wild ox, the progenitor of our domestic cattle, is now found only in the forests lying east of the Baltic Sea.

The *birds* of Europe exhibit greater number and variety of species than its land animals. Aquatic birds, especially, are numerous in its higher latitudes. The stork and the crane belong to western Europe; the pelican, spoon-bill, and scarlet flamingo, to the shores of the Mediterranean.

Reptiles are few, both in number and species, within this division of the globe. The only venomous serpents are three species of viper, found in the south. Lizards, of which there are numerous species, abound in the same localities.

Asia is rich in variety of animal life, and especially so in *mammalia*, nearly all the divisions of which are found within its vast limits. The camel, ox, goat, sheep, as well as numerous species of antelope and deer (all *ruminants;*) the horse, ass, elephant, and rhinoceros (*pachyderms;*) the lion, tiger, leopard, panther, ounce, wolf, hyena, jackal, dog, and fox, with several bears (*carnivora,*) all belong to Asia. The varieties of the ox and antelope tribes are marvellously great. The Asiatic lion, however, is now only found within a comparatively limited range, from the banks of the Euphrates eastward to the Indus. The tiger inhabits all middle and south-eastern Asia. The *quadrumana* are found in the south-east, and most numerously within the islands of the Malay archipelago, where the ourang-outang (Malay peninsula, Sumatra, and Borneo,) and the gibbons, or long-armed apes, are amongst the wonders of the tropical forest.

Birds.—Eagles, vultures, falcons, owls, and hawks, are amongst the Asiatic birds of prey (*rapaces*,) and most of our domestic poultry came originally from south-eastern Asia.* The peacock is a native of India, the golden pheasant belongs to China, and the birds of paradise to New Guinea and the adjacent islands.

Reptiles are numerous in southern and south-eastern Asia, especially in its insular regions. The python (only inferior to the boa-constrictor of the New World) is found within the larger islands of the Malay archipelago, and numerous poisonous snakes in India and elsewhere. The locust, among insects, is the scourge of Western Asia, and, in greater or less measure, of the Mediterranean coasts throughout.

Africa is richer in *mammalia* than any other continent, and especially so in respect of the carnivoras, ruminants, pachyderms, and quadrumana. The lion, panther, leopard, wolf, fox, hyena, and jackal, are among the representatives of its *carnivora.* The numerous species of antelopes and oxen, together with the camel, in the northern half, and the giraffe of southern Africa, take the most prominent places among the *ruminantia.* The elephant, rhinoceros, and hippopotamus; the wild boar, zebra, and quagga, are among the African *pachydermata.* The elephant is dispersed, in immense herds of from one to three hundred, over all the wooded regions of Central and Southern Africa, and the rhinoceros frequents the same localities. The hippopotamus is found within the upper part of the Nile-valley, and in all the lakes and rivers to the south of the Great Desert. The hippopotamus is *peculiar* to the African continent—that is, it is found in no other division of the globe.

The African *quadrumana* include a numerous variety of monkeys, baboons, apes, and lemurs, which are found in vast numbers throughout this continent. The chimpanzee and the gorilla of its western coasts are among the most remarkable, on account of the resemblance which, in point of structure and external aspect, they present to the human figure. The gorilla inhabits the forests in the neighbourhood of the Gaboon river, close to the equator; the chimpanzee has a much more extended range.

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* The guinea-fowl, however, is African, and the turkey came originally from America.

Birds.—The ostrich is perhaps the most characteristic of African birds, and extends its range from the northern borders of the desert nearly to the opposite extremity of the continent. The woods of tropical Africa abound in parrots and paraquets, with many others of bright and gaudy plumage, as the beautiful sun-birds, (which are scarcely larger than the humming-birds of America,) together with the golden-coloured orioles, crested hoopoes, bee-eaters, and others.

Reptiles. — The crocodile inhabits the rivers of tropical Africa, and is abundant in the lower portion of the Nile valley. The huge python, sometimes above twenty feet long, (though inferior in size to the boa of the New World,) is found in the swamps and morasses of the Western coast, and some species of the cobra, or hooked snake, occur, chiefly in Southern Africa and on the shores of Guinea.

Insects abound in Africa. The termites, or white ants, of Western Africa, are among the most destructive members of the insect family—furniture, books, clothes, food, disappearing before their ravages. They build for themselves pyramidal or conical nests, firmly cemented together, and divided into several apartments, so large that at first sight they appear in the distance like the villages of the natives.

America.—All the orders of *mammalia* are represented in the zoology of the Western continent. Excepting in the instance of the great white polar bear, which inhabits the high northern latitudes of either hemisphere, and of a few of the smaller fur-bearing quadrupeds, the native animals of America are of different species from their representatives in the Old

World, and are generally of inferior size and powers. In place of the lion, America has only the puma ; and the tiger of the Old World is represented by the jaguar, the most formidable of the American *carnivora.*

The *ruminants* of the New World include the bison, or American buffalo, (a magnificent animal, vast herds of which, though greatly thinned by the hunter, are found within the prairies in the neighbourhood of the Rocky Mountains,) with the elk, or moose-deer, the musk-ox, the big-horned sheep, and the Rocky Mountain goat.

The South American ruminants include the llama, alpaca, guanaco, all members of the same family, which inhabit the high regions of the Andes, and were early domesticated by the native populations.

The tapir and the peccary (both resembling a hog in shape, but the former distinguished by the peculiar form of its snout) are two of the most characteristic of the American *pachyderms.* The peccary is found only in the New World ; a tapir of different species is native to Sumatra and the Malay peninsula. Opossums (*marsupialia*) are numerous in South America, and are found as far to the north as Virginia.

Of *rodents*, South America has the paca and the agouti, (or cutia,) which take the place of the hare and rabbit of the Old World, though differing in many particulars from them. Both of these are used as food. The chinchilla, which inhabits the Chilian Andes, is valued for its fur. The sloth, ant-eater, and armadillo, represent the *edentata* of the same continent.

The *quadrumana* are most numerous within the Brazilian forests, where the howling-monkeys make the most frightful cries : with the exception of one species, which inhabits the upper part of the Amazon region, all the monkeys of the New World have long tails. The marmosets, a family peculiar to America, are numerous within the Amazon region.

Birds.—These rival, in tropical America, the feathered tribes of any other region in point of splendour of plumage, and the condor of the Andes is the largest specimen of the vulture tribe. The toucans (of which there are numerous species, all distinguished by the large size of their bills) are peculiar to tropical America. The family of humming-birds is peculiar to America, and ranges upon its western side from the southern extremity of the continent as far north as the parallel of 60°, though confined on the Atlantic side within much lower limits to the northward.

Both *reptiles* and *insects* abound in the New World, over the greater part of which, (and especially within its tropical regions,) abundant moisture and dense vegetation combine to favour their development. The rattle-snake occurs both in North and South America; the boa-constrictor only within the swamps of the latter. Huge caymans, iguanas, and other lizards, abound in the same region.

Australia is altogether distinct, in respect of its zoölogy, from any other division of the globe. Not a single one of its indigenous animals is found native to other lands, and the list of its *mammalia* is more scanty than is the case with any other region. Its largest animal is the kangaroo, which is nowhere found but on the Australian mainland, and the neighbouring island of Tasmania. The marsupial order, to which the kangaroo belongs, is wholly unknown in the continents of the Old World, and is only represented in America by the opossums.

Two-thirds of the total number of Australian mammalia are marsupials. On the other hand, Australia has no ruminants, no pachyderms, no quadrumana, amongst its native animals. The duck-bill, or platypus, a small animal of semi-aquatic habits, about twelve or thirteen inches long, with the body of an otter, a bill like that of the duck, and which lays eggs, while it also suckles its young, is the most curious and anomalous of the Australian fauna. The fur of the platypus, which ranges from silver-gray to black, is of some value.

Birds.—Amongst these are a vast variety of the parrot tribe, comprehending paraquets, cockatoos, and others, distinguished by the most beautiful plumage. The birds of prey, (*rapaces*,) include eagles, falcons, hawks, and owls. The emu, or cassowary, a kind of ostrich, inhabits the interior wilderness, but is rapidly becoming diminished in numbers. A numerous family of honey-suckers takes the place of the humming-birds of America.

The native reptiles, insects, and fishes, of Australia are equally distinct from those of other lands.

XV.

GEOGRAPHICAL DISTRIBUTION OF MAN.

Population of the Globe.—The earth is supposed to contain, at the present time, about twelve hundred millions of human beings, distributed in the following manner:—

EUROPE	has	280,000,000	inhabitants,	being about	76	persons to	a square mile.
ASIA	,,	700,000,000	,,	,,	41	,,	,,
AFRICA	,,	100,000,000	,,	,,	8	,,	,,
NORTH AMERICA		45,000,000	,,	,,	5	,,	,,
SOUTH AMERICA		7,000,000	,,	,,	2¼	,,	,,
AUSTRALIA	,,	1,500,000	,,	,,	½	,,	,,
POLYNESIA	,,	1,000,000	,,	,,	1	,,	,,

Asia has by much the largest number of inhabitants, absolutely, but Europe is relatively much more populous than Asia, surpassing, in this respect, any other division of the globe. The continents of the New World are very much less populous than the older-known divisions of the globe, though possessing capabilities fully equal to the latter. Australia also is at present but very thinly peopled.

Mankind are generally regarded as divided into five great families (or races)—all sprung from a common parentage. These families are distinguished by the terms *Caucasian*, *Mongolian*, *Negro*, *Malay*, and *American*.* The distinguishing points of difference between these families are found chiefly in the varying colour of the skin, eyes, and hair, with the curled, lank, woolly, or frizzled condition of the latter; and in the varying shape of the skull, which exhibits a flatter and more receding forehead in the case of the other races than in that of the Caucasian, and departs furthest from the type of the latter in the Negro and the American.

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* Some writers allow only of three varieties—Caucasian, Mongolian, and Negro—regarding the Malay and American as sub-varieties, the former of the Caucasian, the latter of the Mongolian family.

1. **Caucasian.**—This term has been employed from the supposition that the neighbourhood of Mount Caucasus exhibits—in the instances of the Circassian and Georgian populations—the most perfect specimens, in so far as mere physical development goes, of mankind. In so far as colour is concerned, the Caucasian is the *white* variety of the human family. Its distinctive attributes are—the oval form of the skull; the face oval, the features moderately prominent, the forehead arched, the cheek-bones slightly projecting, the mouth small, the chin full and round; the skin generally of light colour (varying, however, from white to a deep brown or swarthy hue,) the colour of the eyes and hair various, and the latter often curling.

In point of geographical distribution, the area over which the Caucasian family is spread in the present day is nearly co-extensive with the habitable globe. Western and South-western Asia, nearly the whole of Europe, and the northern belt of Africa, form their proper home. Thence they have spread, in the course of colonisation, over nearly every part of the New World, as also over Southern Africa, with the more distant regions of Australia and New Zealand.

2. **Mongolian.**—This variety of the human family is distinguished by a greater squareness in the shape of the skull, (viewed from above,) with more prominence in the cheek-bones. The forehead is comparatively low and slanting; the face and nose broad and flat; the eye deeply sunk, with the inner corner slanting towards the nose; the complexion of an olive or yellowish-brown colour, the hair lank and black, beard scanty, the stature below the European average, the frame generally broad, square, and robust, with high shoulders, and the neck thick and strong. These attributes are much less strongly marked in the case of some nations of Mongol descent than in others.

The name Mongolian, applied to this branch of the family of man, is derived from the nomade races who people the upland plains of Central Asia. It comprehends, besides the Mongols proper, the vast population of China (above a third of the human race,) together with the Burmese, Siamese, and other inhabitants of south-eastern Asia, and the native tribes of Siberia. The Turks, Magyars, Finns, Samoyedes, Laplanders, and Esquimaux, are regarded as derived from the Mongol stock.

In point of colour, it is customary to speak of the Mongol as the *yellow* variety of man.

3. **Negro.**—The negro, or *black* variety of the human family, is distinguished not more by the colour of the skin than by the woolly hair, thick lips, and elongated skull, which are among the prominent attributes of the race. The eyes, as well as the skin, are black; the nose broad, flat, and thick; the cheek-bones prominent; the jaws (especially the lower one) narrow and projecting; the palms of the hands and soles of the feet flat; the forms of the arms and lower extremities generally clumsy and ungraceful. Some of these attributes, however, are very greatly modified in the case of many African nations.

Africa, south of the desert, is the proper home of the negro race. Nations of the true negro stock occupy by far the larger portion of that continent, and especially of its central portions. Within the basins of the Niger and Lake Chad, however, and also upon the eastern coasts, Arabs have been settled during many centuries. In the extreme south of Africa are the Hottentot and Caffre families, who are generally classed as sub-varieties of the Negro stock, though presenting some well-marked points of difference. The colour of the *Hottentot* is a dark and yellowish brown; the hair short and frizzled, and distributed in tufts; the stature short. The *Caffres* are well-made—the limbs of rounded form, the skin of a deep brown colour, the hair short, black, and curly, but less woolly than that of the Negro.

The Negro race, through the iniquities of the slave trade, has been transplanted from Africa to the other side of the

Atlantic, and forms a considerable item in the population of the New World.

The native people of Australia and Tasmania (the latter now all but extinct,) with the inhabitants of New Guinea, the Louisiade archipelago, New Britain, the Solomon Islands, New Hebrides, New Caledonia, and the Feejee Islands, are regarded as a sub-variety of the Negro stock, and are classed as *Austral-negroes*, or *Papuans*.

4. **Malay.**—Besides the distinguishing attribute of colour, which is *brown*, the Malay family of man have lank, coarse, and black hair, with flattened faces and obliquely-set eyes. Their stature is below that of the Caucasian and Negro varieties.

The true Malay family comprehends the inhabitants of the Malay peninsula and the adjacent islands (mixed, in the case of many of the latter, with other tribes,) the people of Madagascar, the New Zealanders, and most of the islanders scattered over the vast Pacific, from the Sandwich islands in the north to New Zealand in the south—including the Society, Navigator, and Friendly groups. It is thus scattered over a vast area, from Madagascar in the west to the Marquesas group in the east (nearly half the globe in the direction of longitude,) and from the Sandwich Islands in the north to New Zealand in the south (nearly 70° of latitude.) In many of the Polynesian groups, the brown or Malay races are intermixed with tribes of black or Austral-negro stock.

5. **American.**—The native races of America, who form the *red*, or copper-coloured division of mankind, are confined to the New World. Their distinguishing attributes, besides the colour of the skin, are—long, coarse, black hair (never crisped like that of the negro, or curled, as that of the white often is,) with scanty beard; the cheek-bones are prominent, but more arched and rounded than in the case of the Mongol; the eye generally deep sunk, and, as in last-named race, with a slight obliquity inwards. In point of temperament the Indian (as the native inhabitant of the American wilderness is called)

is cold and phlegmatic to an unusual degree, and he manifests an extraordinary insensibility to bodily pain. His senses of sight, hearing, and smell, are remarkably acute.

The native races of South America are in general farther removed from the higher typical attributes of the Indian family than those inhabiting the northern division of the New World, and they become more and more degraded towards its southern extremity. Some of the tribes who dwell in the Brazilian forests exhibit an intense degree of personal ugliness (produced, in great measure, by artificial means, as the flattening of the head and the prolongation of the lower lip,) and the native savages of Tierra del Fuego are among the most mis-shapen and degraded of the human race. Thus the races, as a whole, depart farther from the highest physical type as they become farther removed from Western Asia, within which the original home of man was planted. The extremes of degradation are found in the native populations of Patagonia and Tierra del Fuego in one direction, and farther Australia in another.

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- 40 Canada
- 41 Central America
- 42 West Indies
- 43 South America

Ancient Maps.

- 44 Palestine
- 45 Orbis Veteribus Notus
- 46 Orbis Romani, pars Occidentalis
- 47 Orbis Romani, pars Orientalis
- 48 Græcia Antiqua
- 49 Table of the comparative Heights of Mountains
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